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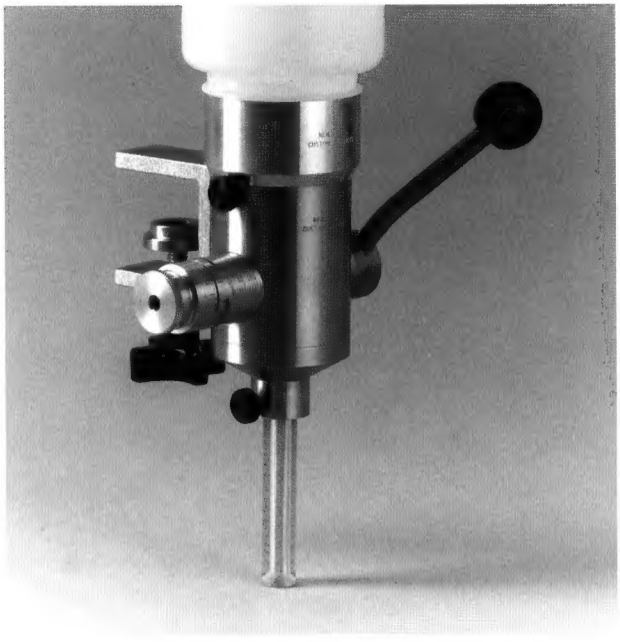

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There Ain't No Free Lunch

or How To Drive Yourself Crazy With Ballistic Tables

BY ROY WILSON

Late last fall after what turned out to be our last shooting event of the season, we were standing around talking about the days meet when one of the newer members of the club approached me about having a new rifle built for 'F' class shooting the next year. 'F' class is a Canadian DCRA class that allows any rifle with a max weight of 14 1/4 lbs, any caliber up to and including 8mm but no belted magnums, any scopes, front rest and rear sandbags. Range distances are usually 300 to 1000 yards or meters. It is much like long range benchrest shooting from the prone.

Of course nothing sparks a good discussion quicker than an opinion on what kind of rifle one should shoot. This then led to the more controversial subject of what cartridge/caliber/bullet 2 should be used in it. One can well imagine the various differences of opinions expressed and before anyone came to blows I volunteered that all we will have to do is just consult the ballistic tables for the various bullets and velocities and if one is any better than the other it will become readily apparent. I thought at the time that this should be a reasonably simple thing to do but it did not turn out that way. Having said that, a lot of very interesting and enlightening information did come out of the study and I will try to pass it along to you.

Have a look at the accompanying ballistic charts and try to familiarize yourself with the data as we will be referring to it as we go along. I will explain what the numbers in the charts mean.

I have selected seven calibers that are the most popular for long range target shooting and have the best selection of match grade bullets.

The first column is the weight of the bullet in grains, the second is the type and manufacturer of the bullet. The bullets selected are a cross section of the types of bullets that are commonly used for long range target shooting. The Sierra Matchkings and Berger match bullets are quite popular and the ballistic data was readily available so these two types were selected. Not all of the available match bullets were analyzed for each caliber, only a representative sample was selected. Both regular profile and VLD (very low drag) bullets were selected to show the difference in downrange effect of the two types. The purpose of the chart is not to show any advantage of one brand of bullets over another but to show the effects the different types and sizes of bullets have on a flight path.

The number in the third column is a non-dimensional number, that is, it does not measure anything physical only a relationship. This is number I have created to represent the resistance of the bullet to the pressure force behind it.

Possibly there is a better formula to represent this but I have not come across it. It does seem to give a good value for the comparison of different weights and calibers of bullets. It is obtained by multiplying the weight in grains of the bullet times it's sectional density times 1000. (bullet weight x SD x 1000). Long bullets are heavier per caliber and therefore require more pressure to drive at a set velocity. For the lack of a better term I have called this number the resistance factor. This number has a direct correlation to the case capacity (amount of powder) required to attain a desired velocity. The larger the number (greater the weight per area) the larger the case capacity required for any given velocity.

The number directly below it is the sectional density (SD) of each weight of bullet. SD is obtained from the formula; (bullet weight in grains/7000)/(bullet dia. x bullet dia.) This number is part of the data used to determine the ballistic coefficient of a bullet and is also sometimes used to determine it's penetration ability.

The next column has the ballistic coefficient for each bullet weight. This number was taken from the manufacturers published data and is corrected for each velocity used.

The fifth column contains the recoil generated for each bullet weight and velocity used. Of all the data generated, recoil was the most difficult to get a consensus on. All the computer programs and formulae tried gave a different answer for recoil. I believe most of this difference is caused by differing opinions on the effect of the jet blast out the muzzle. Also I was surprised at the large effect the amount of powder had on recoil.

All the recoil calculations were done

Continued on next page

There Ain't No Free Lunch

Continued

for a 10 lb. rifle with the appropriate charge of IMR4350 powder to attain the listed velocity. A good base line for recoil comparison is the 308 Winchester with a 168 Sierra Matchking bullet behind 50 grains of IMR4350 powder at 2700 fps. in a 10 pound rifle. This represents a typical target rifle and cartridge combination and it generates 15 lbs of recoil.

The sixth is the muzzle velocity in feet per second (fps) for each of the different calibers and bullet weights. The first velocity figure represents the maximum practical average velocity attainable with large standard size cases. In the case of the 22 caliber this is the 220 Swift. In the 6mm this is the 240 Wby. Magnum, the 25 caliber is the 25-06, the 6.5mm is the 264 Win. Magnum, the 7mm is the 7mm Rem. Magnum, the 30 cal is the 300 Win. Magnum and the 338 cal is the 338 Wby. Magnum. While this does not represent 100% accurately the velocities capable for each of the cases it is close enough for this purpose and was necessary for an easier comparison. DO NOT ATTEMPT TO ATTAIN THESE VELOCITIES without gradually working up from a safe load. These velocities are considered to be the maximum and many rifles are not capable of attaining them.

Each velocity steps down 200 fps to give a viable range of data for each bullet size. These velocities represent a range of what would be required for maximum accuracy and different capacity cases. Most ballistic examples have maximum accuracy at approximately 100 to 200 fps less than maximum velocity. While each gun will be different, the numbers shown should be as close as is practical for the purpose of this exercise. All velocity data was taken as a representative average from three different loading manuals.

The next series of six columns is the drop (DP) and wind drift (WD) for each of the velocities. Wind drift was calculated at 10 mph at 90 deg. to the line of flight. These results were obtained by computer for 300, 500 and 1000 yards. These are common shooting ranges and this was felt to be adequate to show the trends required without cluttering up the charts with unneeded data. Trajectory and windage amounts were rounded off to the nearest whole number. This means the maximum amount of error could be .5 inch. This was not considered significant for the purpose of this chart and it makes it a whole lot easier to read. All calculations for trajectory were calculated for sea level at 59 deg. temp., 29.5 in. of barometric pressure and 78% humidity.

I have noticed some difference on the windage and drop calculations between different computer programs and published ballistic charts. The amount of error is very small up to the 500 yard ranges but then increases at ranges out to 1000 yards. It is not consistent and shows up more with some bullets than others. I do not know why this is but I am assuming it is the result of errors when the BC is calculated for different velocities. I do not believe this small amount of error is important for these comparison purposes.

After studying the charts at great length I have come to the following conclusions;

The weight of the bullet in relation to its bore size has the largest effect on the pressure required to drive it, therefor it has the greatest effect on velocity. Bullet weight by itself has no effect on trajectory or windage.

Bullet weight which is a function of it's SD is one of the major factors in determining the ballistic coefficient of a bullet. The other is its profile or shape. The greater the mass of a projectile the greater is its inertia therefor the farther it will travel for a given velocity. That is why sometimes a heavier bullet will have a better ballistic coefficient despite a poorer profile shape.

Note for example the 100 grain and 120 grain 6.5mm Sierra match bullets. One bullet is 20 grains heavier than the other but they both have the same BC and therefor the same trajectory and windage at the same velocity. This is a case where the better profile shape of one bullet overcomes the weight advantage of the other. This is the advantage of the VLD bullet. However the heavier bullet will require a larger amount of powder to drive it at the same velocity, with a corresponding increase in recoil.

Note from the charts how, as the resistance factor increases the velocity has to go down or the case capacity required for a set velocity has to increase. Compare the 95 g. 6mm and the 100 g. 6.5mm bullet at a velocity of 3200 fps. Both the bullets have a similar resistance factor and therefore will require the same size case to drive at the same velocity. As an example a 284 Winchester size case would probably do it, but to get the 6.5 bullet up to 3600 fps. as shown in the chart will require a magnum size case. One should also be aware that smaller size cases are more efficient than larger ones. It will take less powder to drive a 150 g. bullet to 3000 fps. in a 308 than it will to drive the same bullet to the same speed in a 30-06 case and more powder yet will be required in a 300 magnum case.

Weight has a large effect on the energy the bullet has retained at the target. This is important only to its killing power and penetration capabilities downrange. There is no advantage to having high energies for punching holes in a paper target. However the amount of down range energy is of concern to the metallic silhouette shooter in that a certain amount of energy is required to knock over the target. On the opposite side of the fence a bullet with a small resistance factor and a small amount of mass will take a case with with very little capacity to drive it to a high velocity, however these types of bullets generally have a very poor ballistic coefficient and therefor have poor windage and trajectory at long ranges.

The ballistic coefficient has the greatest effect on windage and a lesser effect on trajectory. The effect on trajectory is greatest at ranges of 500 yards and beyond.

A look at the charts will show that bullets with similar ballistic coefficients driven at the same velocity will have identical deflections for both trajectory and windage. For example the 80 g. .224 and the 168 g. 7mm at 2800 fps., the 90 g. 6mm and the 117 g. 257 at 3000 fps. and the 140 g. 6.5mm and the 175 g. 30 cal at 3000 fps. Notice the 300 g 338 bullet, this bullet has the best BC in the chart and at its maximum velocity of 2600 fps it is bested in trajectory by most of the bullets listed at 1000 yards, yet it still has the best windage of them all, however this bullet requires a huge case (340 Weatherby size) to get even this modest velocity. The difference in spread on drop between all the bullets listed at maximum velocity is only 11 inches at 300 yards this changes to 168 inches at 1000 yards.

The velocity has the greatest effect on trajectory and a lesser effect on windage.

This shows up the most at the longer ranges. Typical increases in velocity of 200 fps will show a decrease in trajectory of about 10 to 15% but a decrease in windage of only 5% to 10% at 1000 yards. Note the 30 cal. 168 g. Match-King, the change in drop over 400 fps. at 1000 yards is 106 inches (35%) but the change in windage is only 18 inches (22%)

The optimum velocity for most cartridges seems to be in the 3000 to 3500 fps range.

Trying to drive heavy, high ballistic coefficient bullets at velocities greater than 3500 fps will require high pressures, very large capacity cases and long barrels. Light bullets are easily driven at high velocities but their low BC causes them to lose velocity at a fast rate and their windage is very poor especially at long ranges. At the other end of the scale trajectory drops off at a greater rate at velocities under 3000 fps. than above, this is due to the fact that a trajectory is like a parabolic curve, the further the bullet gets from the barrel the more it slows down and the steeper is the trajectory. Keeping velocities in the 3000 to 3500 range will give the best compromise. For example look at the 30 cal. 155 g. VLD bullet and the 180 g. HPBT bullet, both have a similar BC so the windage and drop should be the same, and indeed, if you look at the common velocity of 3000 fps. for both, you will notice that the difference out at 1000 yards is only a couple of inches. However for the same size case the 155 g. bullet can be driven about 400 fps. faster giving an advantage in drop of 82 inches and of 15 inches for windage.

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Use the bullet that shoots best in the gun you are using.

The best trajectory and least windage in the world will not help if you cannot hit the target consistently and accurately. It is typical of most rifles to be picky about the type of bullets they digest so this should be the major factor in determining which bullet to select.

Use the largest caliber and heaviest bullet that you can handle for the length of a full match.

Rules governing the weight of the gun and/or the use of muzzle brakes as well as your tolerance for recoil are going to determine how powerful a cartridge you can shoot. Recoil is a very personal thing, some people can easily handle a 7MM magnum, others quiver at a .243, still others say recoil is no problem then their shooting goes to hell after 40 rounds on a hot summer day. You must be comfortable with your gun if you wish to shoot it well. Generally always use the heaviest gun the rules will allow. In our theoretical 10 lb. 308 a 50% increase in gun weight of 5 lbs. for a total of 15 lbs. will cause a reduction in recoil of 33%, or 10 foot lbs. Inversely a 24% reduction in gun weight to 7 1/2 lbs. will increase the recoil to 20 ft. lbs. or 33%. Recoil seems to be harder to take when shooting from the prone position. This is because all of the mass of ones body is directly behind the rifle so there is not the backward give or movement that there is when standing or sitting.

Any bullet with a resistance factor over 5000 is going to require a very large case in order to drive it at a velocity required to avoid a rainbow like trajectory. Bullets of this weight and velocity are better left to the heavy bench guns.

Use the bullet with the best ballistic coefficient possible.

Windage is the most difficult thing for the shooter to compensate for, particularly at long ranges. Any bullet that bucks the wind best is going to be to the advantage of the shooter. While it is easier to compensate for trajectory than windage because a trajectory has a predetermined predictable arc, bullets with a very large trajectories require large scope adjustments with a greater possibility of error. Also a leading or following wind will have a greater effect on bullets carrying a large trajectory, although this is not usually a significant amount.

Smaller calibers and cases are more efficient for their size than larger ones.

The greater availability of a good selection of high ballistic coefficient bullets in the smaller calibers has started a trend toward smaller calibers for long range target shooting.

For example using the 22PPC or better yet the 22BR case driving the heavy low drag bullets. These little cases are capable of driving the 80 g. VLD to 2800 fps velocities with excellent accuracy as well. Compare the ballistics from it to the ballistics for the 7mm 168 g. bullet at the same velocity. Since the drag coefficients are identical the trajectories and windage are identical, yet to drive that 168 grain bullet to 2800 fps will require a magnum size case and over twice the powder required by the 22BR with no gain in ballistics. Recoil will be substantial as well, over three time as much.

Be aware of the consequences of using very low drag bullets.

VLD bullets are longer and have their center of mass located farther back than normal bullets, requiring a faster twist to stabilize. Heavy bullets for their caliber and most of the heavier VLD bullets will require a very fast twist barrel. Above 70 grain in the 22, 100 grain in the 243, 120 g. in the 25, 140 g. in the 264, 168 g. in the 7mm and 200 grain in the 30 cal. will generally all require a faster twist barrel. This type of barrel may have to be special ordered at a corresponding increase in price but it also limits one to a very narrow selection of bullets. VLD bullets seem to be much more sensitive to changes in seating depths and their long profile shape may require the throat length and angle to be changed as well. Also they are very long and if they are to be used in a magazine the loaded cartridge may be too long to function.

Pick a caliber and bullet that suits the type of shooting you are doing.

High ballistic coefficient bullets offer almost no advantage in ranges of 300 yards and shorter and a slight advantage at ranges out to 500 yards. However, ranges beyond 500 yards is where they really stand out. A look at the chart will

Continued on next page

There Ain't No Free Lunch

Continued

show very little advantage between all the bullets listed in trajectory until we get over 500 yards and the advantage in windage really shows up at the 500 to 1000 yard ranges.

At ranges of less than 300 yards a shooter would do well to consider one of the lighter small caliber bullets. The difference in the charts for drop and windage at 300 yards for all the bullets listed at maximum velocity is 11 inches and 6 inches respectively. This is not a lot considering the wide range of bullets shown.

It would not be unusual for some shooters to use a light bullet for ranges out to 300 yards, a medium weight bullet for ranges from 300 to 600 yards and a heavy bullet for ranges out to 1000 yards thereby keeping the effects of recoil down and taking advantage of the better ballistics of the heavier bullets at the longer ranges.

There ain't no free lunch!

Studying the data shows clearly that one cannot get something for nothing. For any given case size a heavier, high BC bullet will require a loss in velocity. A lighter bullet can be driven faster for a better trajectory but there will be a loss in windage at the longer ranges. The key here is to use the ballistic charts to determine if there is any advantage to using a heavier bullet. If the lighter bullet can be driven fast enough to make up for the higher BC advantage of the heavier bullet then the lighter bullet is probably the way to go. If you go to a bigger case holding lots of powder to drive the heavier bullet at a higher velocity you will pay for it in increased recoil as well as a higher cost for powder and cases. There is a point of diminishing returns. Have a good look at the newer VLD bullets in the smaller calibers, I think this is the way more shooters will be going in the future.

While there is no magic combination I hope you can use the information presented to make your own determination of what combination will work best for you.

BALLISTICS AND BULLET DATA CHART

22 CALIBER .224 DIA.

WGHT.	RES.	RECOIL	COEF.	BULLET	VEL.	300DP	300WD	500DP	500WD	1000DP	1000WD
55 gr.	864	5.3 lbs	.249	Ber FB	3800	14	9	49	29	396	194
	.157	4.7			3600	16	10	55	31	445	174
		4.2			3400	18	10	62	34	502	185
60 gr.	1026	5.4	.276	Ber FB	3600	15	9	52	27	386	150
	.171	4.7			3400	17	9	58	29	439	160
		4.2			3200	19	10	67	32	500	171
69 gr.	1352	5.5	.339	SraHPBT	3400	16	7	53	22	342	119
	.196	4.8			3200	18	8	60	24	395	129
		4.2			3000	21	9	69	27	458	140
80 gr.	1824	5.7	.489	Ber VLD	3200	18	6	54	16	287	76
	.228	4.9			3000	20	6	62	17	332	85
		4.2			2800	23	7	71	19	389	93

6 MM CALIBER .243 DIA.

WGHT.	RES	RECOIL	COEF.	BULLET	VEL.	300DP	300WD	500DP	500WD	1000DP	1000WD
70 gr.	1183	7.9 lbs	.263	SraHPBT	3600	16	9	53	29	413	161
	.169	7.0			3400	18	10	60	31	467	172
		6.4			3200	20	11	69	34	531	182
80 gr.	1552	8.3	.314	Ber FB	3400	17	8	55	25	375	134
	.194	7.5			3200	19	9	62	27	431	144
		6.4			3000	22	10	72	30	498	155
90 gr.	1962	8.6	.410	Ber BT	3200	18	6	57	19	328	98
	.218	7.6			3000	21	7	65	21	381	107
		6.6			2800	24	8	75	23	447	118
95 gr.	2185	8.8	.524	Ber VLD	3200	17	5	53	14	276	69
	.230	7.9			3000	20	5	60	16	318	76
		6.9			2800	23	6	70	18	371	84
107 gr.	2771	9.3	.527	SraHPBT	3000	20	5	60	16	317	75
	.259	7.9			2800	23	6	70	18	370	84
		7.0			2600	27	7	81	19	436	93

25 CALIBER .257 DIA.

WGHT.	RES.	RECOIL	COEF.	BULLET	VEL.	300DP	300WD	500DP	500WD	1000DP	1000WD
78 gr.	1318	9.5 lbs	.287	Ber FB	3600	15	8	51	26	368	142
	.169	8.5			3400	17	9	57	28	419	152
		7.5			3200	19	10	65	30	479	163
95 gr.	1948	10.5	.343	Ber FB	3400	16	7	53	22	339	117
	.205	9.3			3200	19	8	60	24	391	127
		8.2			3000	21	9	69	26	453	138
110 gr.	2618	11.2	.414	Ber FB	3200	18	6	56	19	326	96
	.238	10.1			3000	20	7	65	21	378	106
		8.8			2800	24	8	75	23	443	117
117 gr.	2960	11.0	.410	SraHPBT	3000	21	7	65	21	381	107
	.253	9.5			2800	24	8	75	24	447	118
		8.2			2600	28	9	88	26	528	130

6.5 MM CALIBER .264 DIA.

WGHT.	RES	RECOIL	COEF.	BULLET	VEL.	300DP	300WD	500DP	500WD	1000DP	1000WD
100 gr.	2190	13.6	.421	SraHPBT	3600	14	5	44	16	245	79
	.219	12.0			3400	16	6	49	17	279	85
		10.6			3200	18	6	56	19	321	94
120 gr.	2952	15.3	.421	SraHPBT	3400	16	6	49	17	279	85
	.246	13.2			3200	18	6	56	19	321	94
		11.5			3000	20	7	64	21	373	103
140 gr.	4018	15.4	.535	SraHPBT	3000	20	5	60	16	313	74
	.287	12.8			2800	23	6	69	17	366	82
		11.0	.526		2600	27	7	81	19	437	93
155 gr.	4929	15.4	.570	SraHPBT	2800	23	5	68	16	353	75
	.318	13.1	.560		2600	26	6	80	18	421	86
		11.1			2400	31	7	95	21	503	96

7 MM CALIBER .284 DIA.

WGHT.	RES	RECOIL	COEF.	BULLET	VEL.	300DP	300WD	500DP	500WD	1000DP	1000WD
130 gr.	2990	18.3	.373	SraHPBT	3400	16	7	51	20	311	103
	.230	16.5			3200	18	7	58	22	358	112
		14.5			3000	21	8	67	24	416	123
150 gr.	3990	19.3	.429	SraHPBT	3200	18	6	56	18	316	91
	.266	17.4			3000	20	7	64	20	367	101
			15.2		2800	24	7	74	22	430	111
168 gr.	5006	19.8	.488	SraHPBT	3000	20	6	62	17	333	84
	.298	17.4			2800	23	6	71	19	390	93
		15.2	.494		2600	27	7	83	21	456	102
180 gr.	5742	19.3	.698	BerVLD	2800	22	4	66	13	320	58
	.319	16.7			2600	26	5	76	14	375	64
		14.5			2400	30	6	90	16	448	73

Continued on next page

There Ain't No Free Lunch *Continued*

30 CALIBER .308 DIA.

WGHT.	RES	RECOIL	COEF.	BULLET	VEL.	300DP	300WD	500DP	500WD	1000DP	1000WD
150 gr.	3390	24.1	.417	SraHPBT	3400	16	6	49	17	281	87
	.226	21.7			3200	18	6	56	19	324	95
		19.2			3000	20	7	64	21	376	105
155 gr.	3611	25.0	.484	BerVLD	3400	15	5	47	15	253	70
	.233	22.5			3200	18	5	54	16	289	77
		19.9			3000	20	6	62	17	335	85
168 gr.	4250	24.8	.462	SraHPBT	3200	18	6	55	17	299	82
	.253	22.0			3000	20	6	62	18	346	91
		19.3			2800	23	7	72	20	405	100
175 gr.	4620	23.9	.537	BerVLD	3000	20	5	60	15	313	73
	.264	20.7			2800	23	6	69	17	366	82
		18.1			2600	26	6	81	19	432	91
180 gr.	4878	24.4	.475	SraHPBT	3000	20	6	62	18	339	87
	.271	21.2			2800	23	7	71	20	397	96
		18.7			2600	27	7	84	22	470	107
200 gr.	6020	24.5	.565	SraHPBT	2800	23	5	69	16	354	76
	.301	20.8			2600	26	6	80	18	419	85
		17.9			2400	31	7	95	20	500	95
210 gr.	6636	26.1	.640	BerVLD	2800	22	5	67	14	333	65
	.316	22.4			2600	26	5	78	15	391	72
		19.3			2400	31	6	92	17	467	81
220 gr.	7282	27.7	.629	SraHPBT	2800	22	5	67	14	335	66
	.331	24.1			2600	26	5	78	16	394	74
		20.5			2400	31	6	92	18	471	83

338 CALIBER .338 DIA.

WGHT.	RES	RECOIL	COEF.	BULLET	VEL.	300DP	300WD	500DP	500WD	1000DP	1000WD
250 gr.	7825	35.7	.619	SraHPBT	2800	22	5	67	15	338	67
	.313	31.2			2600	26	5	78	16	398	75
		27.0			2400	31	6	93	18	475	85
300 gr.	11250	40.0	.768	SraHPBT	2600	25	4	75	13	362	57
	.375	34.8			2400	30	5	89	14	429	64
		29.8			2200	35	5	107	16	518	73

NOTES:

Recoil was calculated using a ten pound gun and an appropriate charge of IMR4350 to drive the bullet listed to the velocity listed.

Trajectory and windage amounts were rounded off to the nearest whole number. This means the maximum amount of error could be .5 inch. Windage is claculated for 10 mph at 90 deg. to the bullet flight path.

All distances are in yards. All velocities are in feet per second

All measurements are in inches.

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Shooting SubMOA GROUPS with Cast Bullets IN A FACTORY RIFLE

BY DOUG BARIBEAU (Photos by the author)

Introduction

I started out to use cast-lead bullets in my silhouette rifle for offhand practice so I wouldn't wear out the gun, my shoulder, and my wallet. It didn't take long for my penchant for accuracy to take over. Using some of the methods I learned in Schuetzen shooting, I was soon obtaining accuracy beyond my expectations. After winning several ribbons in a Cast Bullet Association rifle match, I realized not everyone was getting to this level of accuracy.

The methods and results described here will not suit the shooter who wants to drive cast bullets hard and fast. The muzzle velocity is about 1450 fps and the bullet is barely supersonic at 200 yards. This closely matches the flight of my .32 caliber Schuetzen bullets so I didn't have to re-learn wind drift. The mild recoil allows me to concentrate on my benchrest and offhand techniques.

During the development of this loading technique, I tried numerous methods, most of which either didn't improve accuracy or decreased it. The method described here is simple and it works well enough to shoot .700" average size groups at 100 yards. If I list a particular product by name it is because it has proven to be vastly superior in its performance or is the only one of its type available.

The Rifle

The rifle I use to shoot these small groups and the gunsmithing to it are unremarkable. It is a Ruger 77V in .308 caliber with a 1 in 10" twist factory barrel and chamber which is huge. The neck measures .347" and the short throat tapers from .311" to .309". A Timney trigger was installed and the stock was shortened to a comfortable length for offhand shooting. The magazine well was filled with a closely fitted hardwood block and the action was pillar glass bedded with Accurglas. The barrel was free-floated and a benchrest follower was installed. A Leupold 6.5X20 sits on top in Ruger rings.

Bullet Casting and Sizing

During casting, it is important to keep the lead and the mould hot. I keep the lead between 800 and 850 degrees and the mould, and especially the sprue cutter, hot enough that it takes several seconds for the sprue to coagulate. I use a ladle to pour the lead into a single cavity which has been marked with a prick punch on the nose. This mark is located where it will not interfere with either the top punch or the rifling of the barrel.

The bullets fall from the RCBS 180-SP mould at a nominal weight of 186 grains using an alloy of 1:21 tin/lead. They measure .3093" at the cylindrical portion and .3012" at the nose. After air cooling, the bullets are carefully inspected and weighed. Any bullet not passing inspection or weighing within .1 grain of nominal weight is used for offhand practice or warm up.

It is important to allow the bullets to setup for at least 24 hours before starting the the sizing process. Hornady gas checks are installed while sizing, not separately. I just spread several of them on the loading bench with the cups up and press the base of the bullet down into the cup before sizing. The bullets with the gas checks are placed in the sizer with the mark on nose in the same relative position. The handle is pulled down to the bottom of the stroke and then a firm enough pull applied to mould the gas check and the base of the bullet together.

It's hard to describe how hard this pull is [about four pounds] but I can feel the base of the bullet yield to the concave surface of the gas check, then offer more resistance. I have cut several bullets apart and, contrary to popular thought, the base of the bullets are markedly dished while the gas check will change shape only slightly.

This seating of the gas check is like seating a primer "by feel" fully into a clean primer pocket without crushing the pellet. Anyway, I raise the handle and take a second stroke without turning the bullet in order to fill all the lube grooves and check that the gas check is fully seated. On this second stroke and pull, the feeling at the bottom should be solid.

I honed out the nominal Lyman .309" sizing die to .3093", the as-cast diameter of the bullet. The nose of the completed bullet is .302" and the cylindrical portion is .3093" and truly round. I periodically check the nose diameter to make sure that I am applying the correct amount of pull. When putting the top punch into the sizer I don't use the set screw at all but just use a bit of lube to hold it in place, allowing it to self-center.

After sizing, I wipe the excess lube from the base of the now completed bullet. This excess is wiped over the surface of the next bullet before the gas check is installed, allowing the gas check to fully seat. I use Javelina NRA formula for all my fixed cast bullet shooting. Finally, the bullets are placed in a wooden loading block made especially for this purpose.

Cases and Case Preparation

I use Winchester PALMA match cases. They are remarkably uniform in neck wall thickness and weight. Original case preparation included uniforming the primer pockets, deburring the flash holes and checking for uniform weight and length. The necks were measured for thickness and the case rims marked with a small triangular file at the thinnest point. I also annealed the necks using the lead pot method described in the July, 1996 issue of **Precision Shooting**. On-going case preparation starts with wiping the

Continued on next page

Shooting Sub-MOA Groups *Continued*

case necks with bore solvent immediately after firing. Back home I wipe the entire case with paint thinner and run a nylon brush inside the necks before starting the actual reloading process.The cases are neck sized only using a Lee collett die in a single stage press. I take two strokes while neck sizing, partially rotating the case between strokes.

The next step is to run the cases over a Lyman "M" die to flare the case mouth. This greatly eases the seating of the soft bullets, prevents their deformation and provides uniform case neck tension. From there, the primer pockets are cleaned and Remington 9 1/2 large rifle primers seated.

Putting it all Together

The primed cases are charged with 15.3 grains of Accurate Arms #9 powder. The bullets are seated with a Wilson chamber type seating die in a home-made arbor press to an overall length of 2.803", a length my rifle seems to prefer. This places the front of the cylindrical portion almost against the start of the rifling. The Wilson seater was reamed to fir a fired, neck signed case by the factory. It is important to note that the mark on the bullet and the mark on the case rim are carefully aligned before seating. Finally, the flare of the case mouth is removed with a tapered crimp die.

Bullet Fit and Loading the Rifle

The assembled cartridge fits the rifle well. The fire-formed case body fills the chamber, the clyindrical portion of the bullet fills the throat and the nose is a light push fit into the rifling. The seated bullet base is flush with the bottom of the case neck. Nothing to prevent the bulllet from entering the barrel in any way except straight. During the loading of the cartridge into the rifle, the marks on the bullet nose and rim are positioned at 12 o'clock so the thin portion of the neck is directly supported by the upper locking lug.

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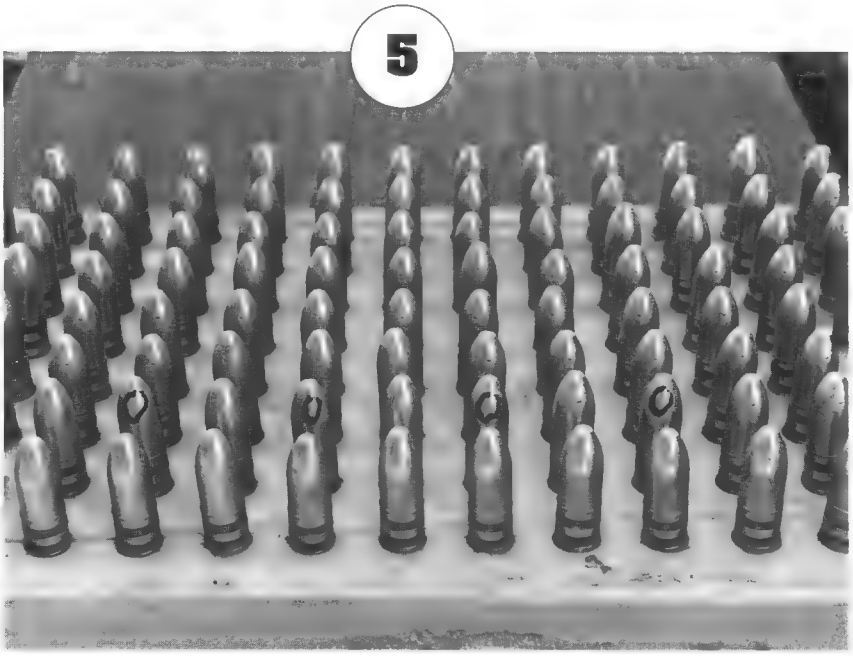
1. *Getting gas checks started by pressing bullet down into cups.*
2. *Starting bullets into sizer with mark on bullet nose in same relative position.*
3. *Excess lube is wiped from bases of bullet and spread over the next bullet to be sized.*
4. *Checking for uniform seating pressure. It is quite surprising how uniformly this can be done.*
5. *Bullets [in wooden block] ready for loading. Orientation mark on bullet nose is circled on four bullets in the second row.*
6. *PALMA match cases showing notches on case rims indicating thinnest portion of case necks.*
7. *Closeup of how marks on bullet and case are aligned.*
8. *Closeup of how marks on bullet and case are aligned. Mark is circled on the bullet to right.*
9. *Aligning marks of bullet and case before seating bullet.*
10. *Seating bullets with Wilson chamber type bullet seater and home-made arbor press.*
11. *A tray of completed bullets ready for shooting. All "X's", I am sure.*



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Shooting Sub-MOA Groups

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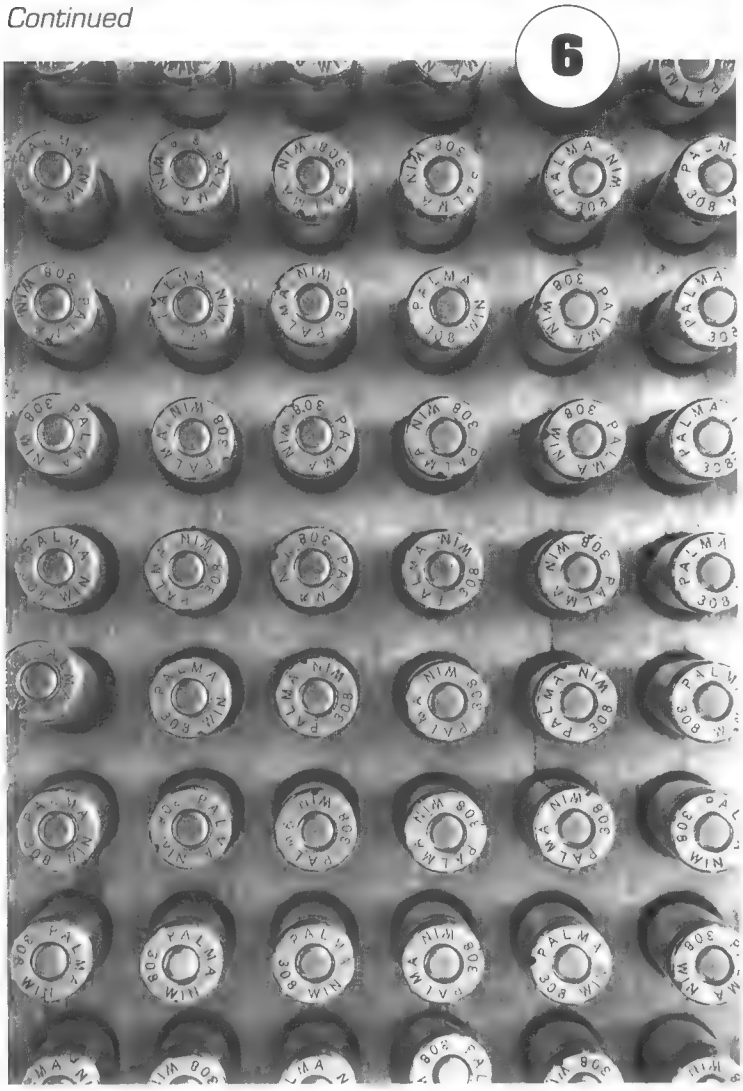

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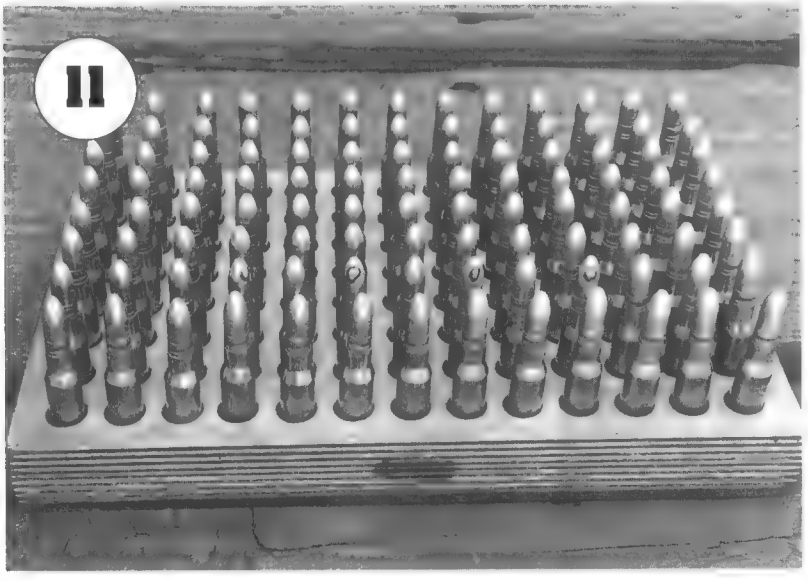

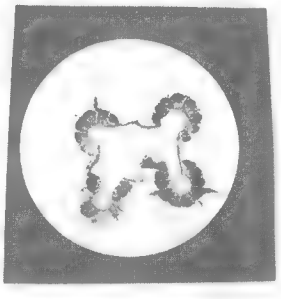

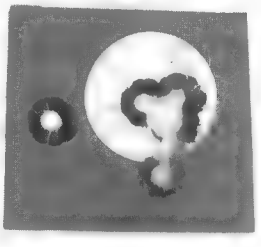

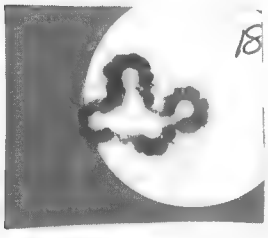

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SIMPLIFIED BRASS LUBRICATION

BY ED FONG

For some of us, loading our own ammo is a hobby in itself. Not as much fun as shooting, but still a pleasant way to pass time. However, I have never found brass lubricating to be much fun. It's a messy business at best.

The first handloading book I got more than thirty-five years ago was titled, *"Why Not Load Your Own!"* by Colonel Townsend Whelen. For lubricating brass cases prior to full length resizing, the Colonel recommended dipping your fingers in a jar of lubricant and then smearing a light coat on the case by rotating it through your fingers. I used that method for some time and then later went to rolling the cases across a lubricated pad. That went on for years until the introduction of spray lubricants. Sprays seemed to me like the next step in the evolution of case lubricating, so I bought a can and got with the program. When it comes to full length re-sizing, the spray lubricants are great. And here is a technique the is faster, less messy, and more economical than the other ways I have tried.

To get started, all you need is a plastic shopping bag. My wonderful "born to shop" wife provides me with a never ending supply of them. So far, I've used this technique with the five or six hundred cases including .223 Rem., 22-250 Rem., 270 Win., 308 Win., and 7mm Rem. Mag. Results have been perfect, and I didn't have to chisel even one case out of a sizing die.

The first time I tried this trick, I put eighty .223 Remington cases in a bag and sprayed the top of the pile for two or three seconds. I then mixed the cases as well as I could by taking hold of the bag near the top, hands opposite each other, and using a shoe shine motion for fifteen or so seconds. Next I repeated the spray and mix process once more before sizing. Every one of those cases went through the sizing die as smooth as silk. It seems lubricant got into the inside neck area of just enough cases so I didn't have to lube them individually. If you don't want spray lube in the case necks, just spray the inside of the bag before you put the cases in. Spray the bottom and a little up the sides of the inside of the bag with enough lube to do the number of cases you have to treat. Now put the cases in and mix well.

During my experimenting with this technique, I used Midway aerosol, Midway non-aerosol spray, Size-All, and One Shot (by Hornaday). One Shot is the only one of the mentioned lubricants that leaves the cases dry to the touch. I was a little concerned that One Shot would dry too fast to be used with this technique, but it worked just fine. Doing it this way, you can lubricate a bunch of cases and then size them at your own convenience today, tomorrow, or next month. It makes no difference.

None of the lubricants I tried have attacked or reacted with any of the bags I used. So just take a case right from the bag and run it through the die. Try it. I think you will like it. Lubricating isn't a big chore anymore. You might say, "It's in the bag."

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WITH
MASTER SERGEANT M. D. GINGHER, U.S. MARINE CORPS RESERVE (RETIRED)

Recently while reviewing the proceeding of the "Firearms" forum on Compuserve I noted a message that asked for information regarding the cleaning of a M1A. At that time I responded with a lengthy description that only broke the surface of the issues relating to the maintenance of the M1A and M-14 rifles. As a result, I decided that I would document the procedures that I followed during the twenty-two years that I spent on the Marine Corps Reserve Rifle Team, and have them reviewed by our former Rifle Team Equipment (RTE) Armorer, Msgt M. D. Gingher, USMCR (retired).

Given our funding situation, it was necessary to take actions that would promote the life of the barrel, and the accuracy of the our rifles. Sad to say, it was often a long wait for a new barrel, or a rebuilt rifle. So we were trained to care for our equipment.

First allow me to review the tools necessary to complete the job. The list below summarizes the tools and supplies required:

a) Cleaning rod. The recommended are the Dewey or Parker-Hale plastic covered rods. DO NOT use the G.I. issue jointed steel rod, it will damage the bore.
b) Gas Cylinder wrench.
c) Gas Cylinder outside clamp.
d) O or P drill bit with handle (for inside piston, and Gas Cylinder Plug).
e) 1/8" diameter drill bit with handle (for inside small section of piston). Many times d & e are available from suppliers with handles attached. They make a good investment.
f) Solvent, Hoppe's, shooter's choice, etc.
g) JB Non-embedding barrel compound or equivalent.
h) Grease (Lubriplate or equivalent).
i) Patches (I like G.I. patches).
j) Acetone.
k) Rags.

For our purposes I will divide the actions necessary into three separate groups: Daily (for each day the rifle is used), Occasionally, and Yearly.

DAILY

Before firing on any day you should:

a) Grease the action. There are five places that require grease (Lubriplate or equivalent): 1) Bolt locking lugs, 2) Operating rod guide on side of receiver, 3) Side of barrel where operating rod makes contact, 4) Hammer top (especially the forward hook), and 5) the point where the disconnector rubs against the operating rod (M-14, only).
b) Place two drops of solvent (Hoppe's #9 seems to be preferred) into the gas system. When taking this action be sure that the piston is blocking the gas relief hole so that the solvent will run along the outside of the piston. Either operate the bolt up and down, or tilt the rifle up and down to distribute the solvent.
c) If your rifle is lugged, torque to the appropriate level (the Marines typically use 60 in/lb.)
d) Conduct a simple Limited Technical Inspection (LTI) ensuring flash suppresser is tight, front sight is tight, and rear sight is tight and set to mechanical zero.

After competing, preferably while the rifle is still warm perform the following:

a) After ensuring that the rifle is unloaded, double over a clean patch and place it between the bolt face and the rear of the barrel. Close the bolt on the patch.
b) Using a .30 caliber brass brush wetted with powder solvent (for this purpose I have no favorite, Hoppe's, Shooter's Choice, both seem to work equally well). Make three passes, re-wet, then repeat for a total of nine passes. Some folks recommend holding the rifle upside down for this procedure. If you have a fixture of some sort that allows for that, make use of it. If you are cleaning on a stool, or the back end of a pick-up with the rifle sideways, you generally will not have a problem with the patch wedged in the receiver.
c) Using clean patches dry the barrel. After this process I never saw the barrel come absolutely clean. However, I never experienced an accuracy fall off as a result.
d) Remove the patch from the action. Place a clean patch around a chamber brush. Insert into chamber and rotate to remove powder fouling, brass chips, and other foreign objects.
e) Using a solvent wet cleaning patch folded twice clean the splines of flash suppresser.
f) Lightly dampen a cloth with a preservative oil (I like WD-40), and wipe exposed metal (do not use a huge amount of oil, just enough to eliminate the potential for surface rust. At the same time remove all of the old grease from the action, bolt

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Maintaining the M1A

Continued

and barrel.

g) If you are not going to be using the rifle for a day or two wet a patch with a preservative oil and make a single pass through the barrel. If you are putting the rifle away for a longer period, say weeks, use a grease to ensure that the barrel does not succumb to rust.

h) Double a cleaning patch and close the bolt onto the patch

These actions are sufficient to keep your rifle operational between practices or matches.

OCCASIONAL

The following activities should be performed on an occasional basis during the competitive season. By occasional I am referring to every couple of competitions or practices. In my case I tried to do this every 200 rounds or so.

a) Preferably with the rifle still warm place a doubled over patch in the action and close the bolt (as described above).

b) Wet a brass brush with solvent and brush the barrel three passes.

c) Push a patch wet with solvent through the barrel.

d) Using a clean dry patch. Place a small amount of JB, or other barrel compound on the patch, and run through the barrel back and forth ten (10) times, doing an extra short stroke for the throat area on each pass. This gives the throat area double the amount of polishing action.

e) Wet three (3) patches with solvent and run through the barrel to remove all traces of the abrasive.

f) Dry barrel with clean patches. Around the third patch should come out clean. If the barrel is still dirty, repeat the process.

g) Remove patch from action, and clean the chamber using a patch over a chamber brush.

h) Using the proper tools for gas system cleaning remove the gas cylinder plug, and the piston.

i) Using proper tools ream the inside of the piston to remove all built up internal carbon.

j) Using some of the JB, or other barrel compound rub the piston to remove any built-up carbon deposits.

k) Using a cloth and solvent clean the piston to remove all traces of the abrasive barrel compound. Both on the surface of the piston, and the recessed rings.

l) Using a short rod and a patch with solvent. Swab out the gas cylinder.

m) Dry the cylinder with clean patches.

n) Using proper tools ream the inside of gas cylinder plug.

o) Clean gas cylinder plug's threads.

p) Wet outside of piston with solvent.

q) Replace piston ensuring that the flat is properly aligned.

r) Replace the plug and tighten to 23 in/lb.

s) Clean front band contact area.

t) Polish front band contact area with crocus cloth.

u) Clean front band contact area of polishing remains.

v) Grease front band.

YEARLY

Based upon typical usage the following things should be done annually. Typically I would do the cleaning at the end of the season (usually late December), and then repeat with the lubrication just before the start of the season.

a) Separate stock from the action group.

b) If possible (some rifles are build so that the removal of the operating rod guide and spring are difficult, and very nearly impossible to re-assemble) remove the operating rod guide, spring and rod. Remove the bolt.

c) Clean bolt, operating rod guide, operating rod spring, and operating rod removing all old grease.

d) Clean underside of barrel, and inside of receiver.

e) Using a preservative oil (WD-40) wipe the areas of the receiver and barrel that do not contact the glass bedding in the stock.

f) Clean all bedding contact points on receiver with acetone or other degreasing solvent.

g) Check the inside of the forearm for signs of rubs from the gas cylinder, operating rod, or operating rod guide. Eliminate those rubs with a wood rasp. Then on a wooden stock seal with True-oil or other stock finish.

h) Clean all receiver contact points in stock with acetone or other degreasing solvent.

i) Re-grease operating rod, operating rod spring and operating rod guide, and reassemble.

j) Clean trigger assembly. I generally disassemble the trigger group once a year to remove all the brass chips, and re-lubricate. The lubrication in this case is the pins, and the points where the hammer spring guide contacts the inside of the trigger group base.

k) Reassemble rifle.

l) For storage in a dry rack I recommend a light coat of WD-40 on exterior metal, and a light coat inside the barrel. I always store the rifle with a GI patch doubled over and trapped between the bolt and receiver. Storing the rifle hanging from the rear swivel is preferred. However, if for security reasons you cannot, the patch helps to prevent the seepage of oil between the glass bedding and the receiver metal. If you do not have a dry place to store the rifle, I would recommend the use of preservative grease inside the barrel for protection. Vapor Phase Inhibitor (VPI) paper around the rifle will help to prevent surface rusting.

In our experience by following the actions listed above a well-made M-14 or M1A should last for in excess of five thousand rounds accurately. Moreover, by conducting the lubrication, and chamber cleaning your potential for malfunctions will be reduced.

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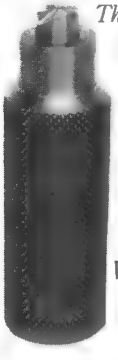

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80 x 223 = 1000

BY JAMES J. CONWAY

When the 223/556 cartridge was first introduced, nobody ever dreamed it would someday be an excellent long range target cartridge. In recent years, with the development of the 80 grain bullets and quicker 1-8 inch twist barrels, the 223 has proved itself to be a very competitive cartridge, indeed often as good as the 308, out to 1000 yards. This fact is not generally accepted by most riflemen regardless of the favorable scores indicated in many match bulletins.

Tradition is probably the reason for this non-acceptance. Every time the Armed Forces has changed rifles or cartridges, great resistance was encountered to the change and it usually lasted for years. Target shooters are not rushing to change from the 308 to the 223, even though barrel life, maintenance, reloading costs, and recoil all favor the 223. Perhaps the small size of the 223 reduces its acceptance as a killer long range cartridge. I'll have to admit it doesn't look like a 1000 yard cartridge. However, looks are very deceiving in this case, for the 223 properly loaded, in the correct barrel, will punch holes in the x and 10 ring at 1000 yards with surprising regularity if you do your part.

The biggest group of skeptics concerning the effective range of the 223 are the numerous military members whose only experience with this cartridge happened in basic training. Many hunters, police, older experienced shooters and the general public share this skepticism. Surprisingly, it is the new competitive shooters who quickly accept the 223. Many of my non-shooting friends have asked me what kind of gun I use. When I answer "a 223", they look at me with that "He needs medical help" look, then when I tell them that I have shot darn good scores with my 223, the disbelief shown on their faces cannot be erased with any explanation. Many make the response that, "You're crazy, nobody shoots a 223 at 1000 yards; I can't even see that far".

Allow me to relate halfway quickly some of my own experiences with the 223 round. In early 1960, the USAF adopted the M-16 rifle (The first of our Armed Forces to do so.) At that time I was a member of the USAF Rifle Team and NCOIC of a test group of 100 basic trainees, shooting the dark green M-16 rifle against an equal number of trainees firing the caliber 30 carbine. The resistance from all the instructors to the possible change in weapons was evident! Test results, at 100 yards changed their resistance. The carbine group was badly outclassed and the reliability of the M-16 made it just about an instant favorite of the instructors. I remember back then marveling at how small the little 223 looked compared to the big 30/06! Most of us felt the test was a waste of time, because the short range utilized for the test (100 yards) could not show the 223's velocity advantage. The USAF then conducted another test at a much longer range, 600 yards, and with better shooters (the Team). The purpose of the test was to determine if the 55 grain bullet would penetrate a GI steel helmet. After many, many shots, with six or seven shooters firing scoped M-16's, at three or four helmets, with the coaches helping, someone got lucky and accidentally hit a helmet. The bullet penetrated one side. End of test, but we were unhappy with the shooting results. The memory of the helmet shooting test still remains with most of the old rifle team members. I know this for a fact, because a few years ago I attended a team reunion with them. When they learned that I and another member still compete, the discussion naturally turned to rifles, equipment, ammo, and scores. They were amazed and skeptical when I told them what I used and then showed them my AR-15 match rifle. They could not believe that anyone, in their right mind, could choose that rifle and cartridge for serious high power competition. I really lost them when I claimed it was an accurate over-the-course rifle. In their opinion, nobody could ever shoot good scores at 600 yards with that combination. So when I stated "I've shot good scores at 1000 yards with it," they offered as argument the failure of the 600 yard helmet test. My explanation of BC, heavy 80 grain bullets and barrel twists simply did not register. The other member who still competes did not attend this reunion and could not substantiate my statements. They asked what he shot and when I answered "a 308", I guess that I lost my case. Maybe they will believe me at the next reunion, for the missing team member (a current US Palma Team coach) is having a 223 bolt rifle built for over-the-course shooting. He is finally convinced that ***the 308 is ok if it's recoil that you want, but if you want the points, the 223 is the way to go.***

It is curious how much the 223 has improved with such simple modifications to bullet and the barrel. Whereas most cartridge developments in the past 40 years or so have been simply to increase the velocity, by changing the case shape, enlarging the case, always more powder, more recoil and less barrel life. Yet (as we found), with very little improvement in extending the actual effective range of the cartridges. The opposite was true for the little 223. More velocity was not the answer. All that was required was a heavier bullet and a barrel twist to stabilize it... which resulted in lower velocity and yet a much greater increase in effective range.

Maybe what is wrong with the 223's popularity, as a long range 1000 cartridge... maybe it's just too good to be true! After a period of years, during which time I experimented with various 308's and 243's. I went to a 223 bolt gun and then an AR-15 match rifle. Many of our club members, most of them excellent shooters, questioned my judgment in selecting the 223. It didn't take many matches to convince them, and myself, that the 80 grain 223 at 600 yards was better than the 308. Either that, or I was suddenly learning to shoot better, for I regularly won many of the 600 stages. I remember my first time at 1000

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Maintaining the M1A

Continued

yards with that 223. Regardless of my recent successes at 600 yards, some of my fellow shooters asked "You're going to shoot THAT at 1000 yards?" I replied that "The 80 grain bullet doesn't know how far it will have to travel," and then I proceeded to beat them all. I had my first 800 yard clean target that day, scoring a 150-9x. Someone was kind enough to cut out the 10 ring for me and I still have the target. Twelve of the fifteen shots held a five inch elevation. The best shot I ever made at 1000 yards was with an AR-15 and an 80 grain bullet. Someone had improvised and made an 8 inch wooden peg to use with the spotter to show the location of the hits. One of my shots hit the peg. That is not unusual. What was unusual was that the angle of the 8 inch peg apparently perfectly matched the trajectory of the bullet, and the bullet proceeded to penetrate four and one-half inches of that peg before emerging! Robin Hood or Errol Flynn couldn't have done any better! I saved the peg and spotter. Most of the doubts concerning the 223 are caused by those shooters having little or no knowledge of ballistics. To them an 80 grain bullet will always be just a light bullet, and that's that. Explaining that it's downright heavy relatively, for a 223 diameter bullet, just doesn't register with them. However, showing them that its weight increase from 55 grains to 80 grains is a 45 percent increase and that the same increase for a 168 grain 30 caliber bullet would increase its weight to 244 grains, they then vaguely begin to understand that a 223 just might hit a target at 1000 yards.

All my 1000 yards shooting with the 223 has been with the 80 grain Sierra bullet, scope sights, with front and rear rests, on the ground. By necessity (I can't see target numbers at long range) I became an "F" class shooter before I ever heard of that class. It was just that I was always testing my rifle or ammunition and wanted the precise aim provided by the scope sight. Anyway, my 1000 scores at Camp Bulllis, Texas were either the highest or in the top second or third place. Many times during practice firing, shooters on the line would compare hits from each and every shot between the 308's and my 223. It soon became evident to everyone there that the 223 at 2850 MV was the equal to or superior to the 308. Also, it was soon established, much to everyone's surprise, that the normal "UP" for elevation from 600 to 1000 yards was the same for the 223 and the 308. That is: ten minutes up from 600 to 800 yards, another five minutes up from 800 to 900 yards and finally six minutes up from 900 to 1000 yards. My opinion, based on firing approximately 300 rounds of 223 ammo at distances from 800 to 1000 yards is that the 223, properly loaded, is every bit the equal of the 308 firing any bullet weight.

Perhaps the low recoil of the 223 increases my shooting ability and that factor improves my scores. That is exactly what I want— a cartridge that will permit me to do my best and still buck the wind as well as the heavier 308 bullets. My last Palma match at Camp Bullis was in March 1997. It was a very windy day (it's always windy at Camp Bullis now that I think about it). My score ("F" class) of 430 was the highest for the day. The winner was Chuck Hathaway, the US Palma Team coach, with a 420 score, firing 190's in a 308. Incidentally, the US Palma Team is scheduled to train this October at Camp Bullis for about a week. Bullis was selected because of the unusually windy conditions encountered there.

My long range load for the 223 consists of WW cases, Remington 7 1/2 primers, 24.7 grains of Varget, 80 grain Sierra MK bullets (molyed), and loaded to an overall length of 2.470.

As I write this I've just returned from the Texas State Rifle Association Championship Match (23-25 May 1997). The winner was Albert Turner, using a 223 AR 15. The match consisted of a regular 800 aggregate, plus a 50 shot National Match Course. Turner's score was a 1260-41x. My friend, and a local club member, Nez Rongero won the first 600 yard stage with a 199-7x. He also won the iron sight category of the 1000 yard any-any match with a 190-5x. He used a 223 AR 15 match rifle. The 223 is indeed a good choice for all serious competitive match shooting.

In August I will compete in a popular match in Canada. I am looking forward to seeing how my low recoiling, super accurate .223 will shoot in the Canadian air! The stages will be fired in five days from 300 yards to 900 meters for a total of 80 shots. It will be a very difficult match. I am looking forward to it.

J.J.

Slow Learner (still!)

BY DAVID DICKSON

Blame this epistle on cabin fever and the worst Alberta winter in thirty years. It is January. The temperature is -27 degrees Celsius and it seems to have been frequently colder and very rarely warmer for weeks. My last visit to the range was at the end of October, just before the first winter storm. I won't get to shoot a rifle again until March or maybe even April. Since I don't collect stamps and can't paint, what else is there to do except think about last year's target shooting and plan for next summer's?

When my previous effort (*PS*, June, 1994) at keeping winter tedium at bay was written, also in the cold short days of January, I had arrived at the position that I needed to learn to judge from flags the effect of the wind on the bullet and had been told more than once that my Hart-actioned 7-08 rifle with its 30" barrel, prone position stock and 3.5 lb. trigger pull was not suitable for serious bench rest shooting.

In the belief that my inability to judge the effect of the wind was a much greater factor in enlarging my groups than was the rifle, which had, in calm conditions, shot groups under .300 MOA with Sierra 168 gr. MatchKing bullets, I decided to work on the wind before contemplating altering the rifle to a proper 6 PPC bench rest rifle.

Having ordered wind flags from Sinclair International, I read again Warren Page's "The Accurate Rifle", Glen Newick's "The Ultimate in Rifle Accuracy", Arthur Pejsa's "Modern Practical Ballistics" and everything relevant in Precision Shooting. I learned that if the angle between the flag and the pole it is flying from is divided by 4, the result is the speed of the wind in miles per hour, though I wondered if the weight of the flag and possibly its shape might not need to be factored into the equation. I was informed that the effect of the wind was proportional to its velocity and to the sine of its angle to the direction of fire. I also learned that a wind acting on a bullet has its maximal effect near the muzzle, the effect of a wind of the same strength and direction diminishing with distance from the muzzle until at the target it is, obviously, zero.

Armed with this information, front and rear rests, two flags with streamers and daisy wheels to display the direction and strength of the wind and my .22 Anschutz rifle (which would make the deflection more obvious than would the 7-08), I drove to the range on a breezy day and set up the rifle on the bench, the flags at 30 and 60 yards and the target at 100 yards.

Judging from the angle of the streamers attached to the tail fins, the wind velocity was at least 10 miles an hour. It was obvious that the two flags never coincided in their indications of either the wind's direction or its velocity, both of which were not just variable but rapidly variable. Feeling that one problem at a time was enough for a beginner, I decided to pay attention only to the nearer. The wind's direction varied perhaps 45 degrees on either side of a very unclear average, while the velocity fluctuated horribly. Diminution to zero did occur but only momentarily. The whole thing was quite daunting, for I had firmly in mind the advice of my mentors that I should fire a shot only when both velocity and direction were in the condition I had selected. Given the rapid fluctuation of each, that was going to be difficult.

Endeavouring to pick a combination of wind from about 2 o'clock, streamer blown out to about 45 degrees and wheel rotating merrily, I fired a shot and saw the little bullet moving to the left as it arched down range to strike well to the side of, but pretty level with, the aiming point. I wasn't at all confident that the wind hadn't altered velocity or backed or veered between the decision to fire the shot and the bullet's departure from the muzzle. The wait for the flag's indications to repeat themselves seemed interminable. It was certainly measured in minutes and even when I fired another shot I had considerable doubt that I had been quick enough to catch the same condition. The bullet didn't land in the same place as the first one but it wasn't too far away. So I tried again - and again - and again, doing my best to catch the same condition for successive shots. This went on for the whole afternoon and then for other afternoons until I was able to arrive at some definitive conclusions, the chief of which are that the principles behind making the appropriate allowance for the wind so that each shot lands in the same place are sound and that the lighter and steadier the wind the more effective and desirable the result, with the optimal condition being, without a shadow of a doubt, a dead calm.

Dead calms are hard to come by on our range, which is located on the side of a ridge at an altitude of 6000 feet close the the eastern edge of the Rocky Mountains. We have lots of wind in Alberta and the closer to the Rockies, the more of it there is and the more short term variable it seems. On the 900 metre range that runs parallel to our bench rest range, one is never surprised to see the flags, situated at intervals down the range, stretched out horizontally from their poles and pointing alternately to 3 and 9 o'clock - but only for a few seconds before they change to another pattern. Experienced wind judgers can cope with this and can put their shots in the bull at 900 metres. I admire their skill.

At the time when I was frustrating myself trying to learn to judge the effect of the wind on the Anschutz's .22 bullet, I participated in a 300 yard bench rest competition with the Hart 7-08, still with its

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Slow Learner - Still!

Continued

prone position stock and, by bench rest standards, very heavy, though crisp, trigger pull. I had to shoot without the, to me, still rather doubtful benefit of wind flags because the 300 yard targets are a little above the firing point and my flag stand is too short at its full extension. My notes say that the wind was gusty and varied between NW and SW through E, which is from about 10 to about 7 o'clock through 3 o'clock. Not being able to see the flag in the sight, I simply loaded and fired without regard to the wind. I was surprised when I learned that the 7-08 with 168gr. bullets had finished halfway up the list of competitors, for they were shooting proper bench rest rifles with proper bench rest 68gr. bullets. I couldn't help pondering whether a bench rest stock and light trigger might help the rifle to do better. I suppressed the politically incorrect thought, especially for a beginner, that a high BC bullet might really be a better approach to 300 yard bench rest in a windy site than a short, light, even if custom made, bullet.

Before any change was made in stock or trigger, the opportunity occurred to take part in the first Alberta egg shoot, modelled after the Carolina Egg Shoot, with no wind flags. The Hart 7-08, shooting against bench rest and silhouette rifles, placed, to my even greater surprise than after the 300 yard bench rest match, first in the 100 yard stage as well as first in the overall competition and hit the egg into the bargain, the only rifle lucky enough to do so. My belief in high BC bullets was strengthened. A bench rest stock and trigger were fitted to the rifle before the next bench rest competition, when, again without wind flags for the same reason as before, it placed second. Shortly after that, the rifle came first in the second Alberta egg shoot, though the number of competitors was small.

The Hart rifle was converted back to its original prone position format, the plan being that, during the winter now miserably ongoing, a 6mm. rifle would be obtained with a twist fast enough for long. high BC bullets. The thinking was that it would be interesting to find out whether these bullets could beat the 68gr. bullets at 300 yards and whether they could also do it at 200 and perhaps even at 100 yards at a windy range. The custom action for this new rifle, ordered a long time ago, has not yet been received, so the winter months, which should have been used for getting it built, are being wasted. The Hart 7-08 is still my only centre-fire rifle. However, the winter has been made interesting by collecting information relating not only to the question of suitable bullets for windy ranges but also to the matter of the way in which bench rest rifles, components and techniques change over time.

My reading of articles and books about bench rest shooting had led me to believe that improvements, exemplified by groups of ever decreasing size, proceeded in a step-wise manner. An idea for an improvement in an action, barrel or other component or in combining or in using components would be tried, proved statistically significantly to be better, written up in Precision Shooting and then generally adopted throughout the sport. The cycle would keep repeating as new ideas occurred to fertile minds.

On looking back over the lists of equipment used in the Light Varmint class of the annual Super Shoots published in Precision Shooting since 1990, when I started to subscribe, little change was found in the actions used by the top twenty shooters. 9 Stolles were used in 1990, 12 in 1991 and 12 in 1996, with a maximum of 14 in 1993. The use of the 6mm. calibre was rather uniform - never less than 15 out of 20, with 16 in 1990,19 in 1996 and 20 in 1995. Unfortunately, the reports no longer state whether the 6mm. rifles were PPC's or something else. Leupold scopes were employed by 15 of the top twenty in both 1990 qnd 1996, with a maximum of 18 and a minimum of 13 in the years between. Bullet weights of the 6mm's, given only in some reports, were preponderantly 68gr., with a few lighter in weight. In the reports in which primers were mentioned, the great majority were of Federal manufacture.

In contrast to these rather uniformly employed components, there were clear changes in others. Shilen barrels, chosen by 2 of the top twenty in 1990, increased in number to 12 in 1996. Users of Lapua cases increased from 4 in 1993 to 20 in 1996. The first appearance of a Vihtavuori powder was in 1994, there being 3 users. By 1996 there were 13. Utilization of 322 powders declined from 18 in 1992 and 1993 to just 4 shooters employing them in 1996.

The pattern of change or lack of change was rather similar for the top twenty Heavy Varmint class competitors over the same years.

When focus changed from components used to group sizes shot with these components, some simple calculations, followed by transfer of the results to graphs, showed that in only one class and yardage (Heavy Varmint, 200 yards) was there any trend to decrease or increase of group size. In this case it was an increase in group size from 1990 to 1996. Certainly there was variation in group size from year to year in LV 100 and 200 and in HV 100, but with the exception of two particular cases to be mentioned below, the variations could be classified as "noise", with the two being a burst of applause and a roaring blizzard.

The calculations found the mean group size for the aggregates of the top ten competitors for each distance in each class in each year from 1990 to 1996. Even in the absence of any clear trends, differences might be expected between the figures for the last and first years. The mean group size for LV 100 improved from .2570 to .2391, for LV 200 it deteriorated from .2493 to .2697, while for Hv 100 it improved from .2250 to .1883. For HV 200 it deteriorated from .2461 to .2939.

The particular case of the mean aggregate group size in HV 100 in 1996 attracts attention not only because it differs markedly from the figures for the years back to 1990 (which fall between .2161 and .2437) but also because each and every top ten shooter had an aggregate under .2000. This is extremely unusual, for in the previous years only three individual aggregates out of the 60 (10 shooters in 6 years) possible in this part of the Super Shoot were under .2000. The rarity is emphasized even further by the finding that only a total of 8 top ten aggregates under .2000 of a possible 240 (10 shooters in 4 classes in 6 Super Shoots) were recorded in 1990 through 1995. (As an aside, one shooter did it twice - in LV 200 and HV 100 in 1991). If the 1995 figure (.2318) were to be substituted for the extraordinary 1996 figure, HV 100 would show deterioration over the years, not improvement.

The other particular case relates to LV

200 in 1994, when the mean of the aggregates of the top ten competitors was .4214, much worse than the largest in other years (.2690 in 1992). The windy, cold weather on this occasion was adversely commented on in the report.

In summary, the mean aggregate top ten group size improved in LV 100, deteriorated in LV200, improved in HV100 and deteriorated in HV 200. It would seem fair to say that, overall, no obvious shrinking of group size in the Super Shoot from 1990 through 1996 was demonstrated by this approach.

Another approach that, since it involves more shooters, might possibly better indicate whether group sizes improved from 1990 through 1996 is to look at the means of the top twenty Light Varmint class grand aggregates and, separately, of the top twenty Heavy Varmint class grand aggregates. The mean LV grand aggregates for 1990 and 1996 at .2858 and .2761 respectively show a small but not statistically significant improvement in group size, while the means of the HV grand aggregates for 1990 and 1996 at .2652 and .2726 respectively show a small worsening of group size. Once again, a fair conclusion would seem to be that, overall, there was no obvious improvement in group size from 1990 through 1996. Whether the top ten and top twenty Super Shoot data are representative of the Super Shoot as a whole and of bench rest shooting as a whole is not known. Certainly one cannot generalize confidently from the performance of 10 and/or 20 shooters in one competition to the whole of bench rest shooting. Nevertheless, the two particular cases, one on each side of an island of sameness, make for a little interesting speculation.

It has to be considered whether they represent departures of the weather conditions from a middle ground of pretty good, consistent conditions, represented for both LV and HV by groups of between approximately .2200 and .2600, to one exceptionally good and one extremely bad state. Certainly, the "bitterly cold and terribly windy" weather on the latter occasion was referred to in the report. If groups of this size range represent the pretty good conditions of the Super Shoot range, I feel that the conditions on our range are rarely as good as that and probably tend toward those on the occasion of the Super Shoot LV 200 .4214. The incomplete records I have for our range show that LV 200 aggregates for our top shooters are often over .4000 and that the best HV 100 aggregates don't approach the .1883 of the 1996 Super Shoot exceptionally good case and are rarely under the .2200 lower limit of the Super Shoot pretty good conditions.

If the Super Shoot top competitors are choosing equipment for perfect conditions, though usually shooting in only pretty good conditions, the use of 68gr. or slightly lighter bullets is understandable. Should we, for our rather more challenging (I hypothesize) conditions, shoot higher BC bullets? There would seem to be only one way to find out.

Reverting to the components which changed over time without evident improvement in performance, one wonders whether the changes were due to following leaders, successful marketing or the results of statistically significant testing which I would like to be aware of but am not. There is always more to learn.

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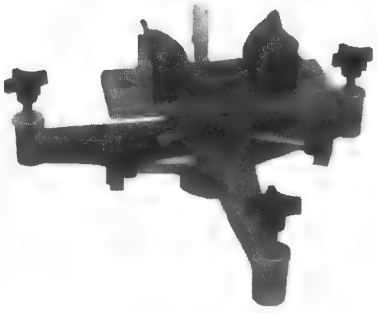

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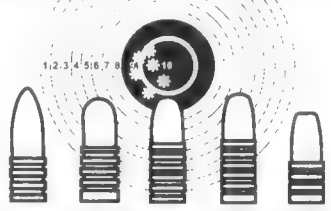

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Bob Greenleaf on "VERY ACCURATE" Cartridges

Dear Dave,

It has happened again! I've just read another article about a new wildcat cartridge that is claimed to be "very accurate". The term itself is a very broad one depending on who reads it. What is "very accurate" to the deer hunter who only fires three shots a year (two to check the sights and one to get his deer) is not the same thing to the competitive shooter or experimenter who fires thousands of rounds a year and keeps good records of group size, load, conditions, etc.

In 1935 the Wimbledon Match at Camp Perry was won by Ben Comfort using a 300 H & H Magnum. In more recent years the match was won with a 6.5mm-06. Neither of these cartridges are considered "very accurate". Their advantage, probably, was the higher muzzle velocity compared to the more popular cartridges of their day. A .30 caliber 180 grain MK bullet having a muzzle velocity 300 fps faster will drift about 2½ feet less at 1,000 yards in a 20 MPH crosswind. That is a big advantage as it allows for some error that a slower bullet can't tolerate. These two cartridges were accurate enough but it was the whole system that won the matches — the shooter, his rifle, and lastly the cartridge.

Anyone who has done a lot of reloading and testing on targets knows that accuracy can vary considerably with changes in velocity and I don't mean variations in a particular load which are indicated by high standard deviations or large extreme spreads. We also know that low S.D.s do not guarantee accuracy. A cartridge/rifle/bullet combination that may give wonderfully small groups at, say, 3,000 fps and yet be quite mediocre at 2,900 or 3,100. Just why this is so is a matter of great debate and discussion and one opinion is as good as any other.

Looking through the various loading (or is it reloading?) manuals and their short essays on the various cartridges you will quite often find the comment that the - cartridge is an "accurate" one. I don't think there is one cartridge that some writer at one time or another has said is not accurate.

The PPC cartridges for years have been regarded as the most accurate cartridges and reading match results would tend to substantiate that. Apparently it is a good combination of several factors such as case capacity, case length/case diameter ratio, small rifle primers, small flash hole, neck to chamber relationship, good brass, etc. The Remington BR cartridges and their variations are also giving good groups but when everyone shows up at a match with a PPC the winning cartridge is decided before the first shot is fired. Too many competitors or would-be competitors feel that a PPC is a must if a chance at winning is desired. I don't believe that it is so. If more shooters used the Remington or Norma BRs or the Waldogs or Talldogs or any other promising cartridges that are available I think the match results would be more interesting to read. 1,000 yard BR is an interesting discipline because of the great variety of cartridges being used today by the winners. We need to learn more about accuracy and what makes a cartridge "accurate" or "very accurate".

I think we can improve a cartridge accuracy potential just by changing the throat design, for instance. A 225 Winchester can be improved by substituting Remington's throat design from the 222 or 223 Remington for the Winchester design.

I dislike the term "tight neck" but certainly a close fit of the neck of a cartridge to the chamber tends to enhance accuracy. What scares me is that the relationship between the two has to be closely monitored or a dangerous condition will result. If I find I can seat a bullet without resizing the neck I reach for my neck turning tools. I don't need BR accuracy when I shoot 300 yards prone. I really need a better hold or position.

A cartridge can deliver better accuracy merely by changing to cases with less thickness runout or by indicating and marking all your cases; a dreadful chore. A cartridge with cases that have .007" runout chambered randomly will be a "dog" compared to that cartridge using Lapua or Norma cases. The "dog" becomes a "very accurate" cartridge without a change in design! We also know how merely changing bullet seating depth can effect size.

I suppose most readers of **PS** would like to be awarded an Official Screamer patch and there is nothing wrong with that. We read what the size of the award winning groups are but we do not know what the true average size group from that shooter-rifle-cartridge combination is. Is it 50% bigger, 100% bigger, or even more? Is the Screamer group just luck? I believe it is in many instances, so really it is good fortune that is being rewarded.

A "very accurate" cartridge depends more on the bullets, the barrel, the bedding, receiver and bolt truing and all the other details your rifle builder takes care of rather than the particular cartridge design chosen. Saying this or that cartridge is "very accurate" is not giving the credit for the accuracy where it is deserved.

FROM RUSSIA *Will Coach ...*

BY JIM MILLER

During mid June, the Sandy Ford Junior Rifle Club, of Streater, Illinois, hosted an N.R.A. Sports Shooting Camp for smallbore rifles. These types of events go on at various localities during most of the summer months at N.R.A. affiliates throughout the United States. Most events at these schools are very predictable, but this school had an unusual guest, a Russian rifle coach. Nikolay Rakov has lived in this country a little over a year while residing in the Chicago area. Rakov is here on a visa and hopes to find a situation or opportunity that will allow him to gain permanent resident status.

During the position instruction phase of the Sandy Ford Camp, Tom Atwood, school director and former Commander of the U.S. Army Advanced Training Unit, started to give a presentation on the standing position to the junior campers. Atwood asked Rakov to demonstrate the position. With a borrowed 1813 Anschutz free rifle, Rakov minus shooting coat, assumed the classic Olympic style standing position with a rock steady hold. Rakov is no stranger to target rifles or junior shooters. In Krasnoyarsk, Russia, "Nick", as we call him, was head coach of a shooting sports school that had at least two hundred students and eight coaches. Previous to this was Nick's army career as a sports shooting professional with participation in several international venues within the Soviet Bloc and rifle championships Nick won in Latvia and Russia. Nick also holds the Russian title "Master of Sport" in riflery. Talk is cheap, but proof is in performance and results. Rakov would have gone largely unnoticed, but he showed up at the 1996 Illinois State three position championship, with borrowed equipment, and won the tournament shooting iron sights against some competitors using scopes. In later efforts, he turned in at least one three position iron sight full course of 1148 with again, borrowed equipment. Recently, he was credited with a 585 fifty meter English match score, under rough conditions, at a local preliminary U.S. Team tryout.

Atwood finished his presentation and asked Nick to give his insights into the shooting position. The words came slowly and haltingly at first. Rakov explained that after the basics that position and techniques will vary with individuals. Techniques that work for one individual will not work for others. The most critical thing is balance. The shooter must achieve a balance or center of gravity that falls somewhere between the shooter's two feet. Some readers may find things "Ho-hum" so far. Well, here are some new twists: Remember, these Olympic style shooting guys can hold a dime without benefit of a heavily buckled and thick U.S. style conventional shooting coat. Rakov stated that prior to assuming that standing position, he "tenses" all the muscles in his body. He does this for at least fifteen minutes prior to picking up the rifle. Once in the position, Rakov relaxes some muscle groups while keeping others tense or under partial tension. This appears to be some form of progressive relaxation. Rakov states that the excitement and emotion connected with the competition sometimes interferes with the rifleman's ability to hold steady. (We are now in the "nitty-gritty" dear reader!) Pure balance in the position may not be enough. Rakov grips the rifle with varying degrees of tension, including pulling the rifle, even if it has a hook butt plate, snugly into the shoulder. Cheek and facial pressure on the stock are also important to a steady hold.

The obvious question is to how do you train all these muscles to do the necessary things that will contribute to a stable position? For those aspiring Russian marksman, who have a firm grasp on the fundamentals, a Russian rocking platform is used. This contraption consists of a sturdy board that is about two and a half feet square. Under the board is about six inches of foam rubber with a large rock (yes, I said rock!) in the middle. The rock acts as a fulcrum. The shooter assumes his position on the board and attempts to balance his position. The shooter must get his center of gravity directly over the fulcrum (rock) to keep the board level and balanced.

The shooter soon learns that this shifting platform requires certain muscles to be conditioned to hold and balance a position. Last winter, Rakov showed this technique to members of the Milan Rifle Club,(Milan, Illinois), and they built own rocking platform. The Milan shootists dubbed the device a "wobble board". Reportedly, several aspiring Milan shooters have noted dramatic improvements in their standing scores in precision air rifle shooting, using the club "wobble board".

Many of the techniques professed by Rakov are variations of or are somehow related to much of the material found in what smallbore shooters call the "Russian Book". This is the classic Competitive Shooting by A.A. Yur'Yev, which is still available in English translation from N.R.A. sales. It is not surprising, in thumbing through this book that, Rakov can point out and identify photographs of many of the mentors of his youth in a system that dominated international shooting sports for decades.

During the Streater Camp, we coaches found Rakov to be a quiet and modest individual who likes working with the junior shooters. Advancement beyond his current entry level instructional situation is doubtful. Nick lacks appropriate N.R.A. class "C" or class "B" coaching credentials and his current command of English probably would not allow his to pass the tests. If the reader happens to hit the Illinois indoor rifle circuit next winter, you may meet Nick Rakov. He communicates easily with shooters and an attentive individual can always learn something.

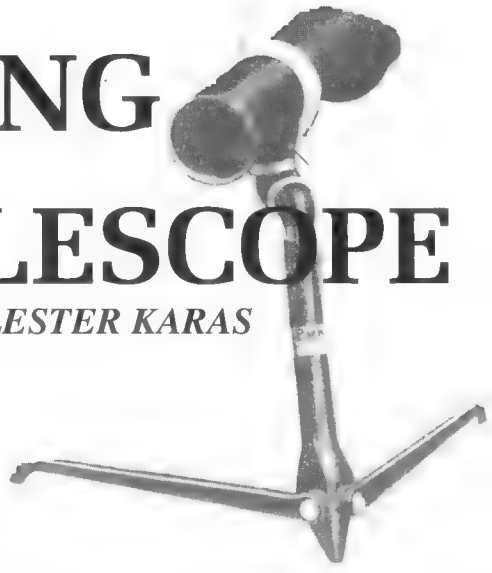
If any Precision Shooting reader desires information about Rakov or Sandy Ford Shooting Camps, call Jim Kinkade at 815-673-2119. To communicate with Nikolay Rakov, call 773-271-6395.

The benefits of the end of the cold war are obvious to all of us who remember school nuclear attack drills and the Cuban missile crisis. One benefit had a personal touch at a recent Sandy Ford Junior Shooting Sports Camp.

Continued on next page

SELECTING & USING the SPOTTING TELESCOPE

BY LESTER KARAS



Introduction

Participation in the sport of high power competitive rifle shooting is not possible without proper equipment. Without exception, the rifle and sighting equipment must be obtained as early as possible, and of as high a quality as the shooter can afford. To the rifle and sights must be added the sling, and other accessories such as the shooting jacket, and score book.

Perhaps the single most useful accessory to the target shooter, after a proper rifle and sling, is that of the spotting telescope. A good scope is necessary to enable the shooter to spot the position of his shot on the target. But the scope is used for far more than just observing the target after a shot, or of resolving details on the target when scoring for one's shooting partner. Properly used, the spotting scope becomes extremely useful in the determination of wind.

Wind will blow even a Boeing 747 jetliner off course, and similarly wind will also affect the course of the bullet. Determination of wind velocity, up to about 8 mi./hr. and consequent sight adjustment, may be inferred from images seen through the scope.

Scope Function

A spotting scope, properly used, is capable of the following:

1. Its primary function is to enable the shooter to determine the point on the target which was struck by the bullet.

2. Its secondary function is that of reading mirage, which is in actual fact, observing visible waves of heated air. These indicate the movement and velocity of air on the range through which the bullet will travel, and from this observation, the velocity of wind may be inferred.

It is an established fact that the secondary function of the spotting scope, as noted previously, has become more important to the shooter than its primary function. And this must be kept in mind when choosing the scope.

Choosing the Scope

In obtaining a spotting scope, one must choose the best quality which one can afford. This factor will automatically rule out the draw tube telescope in favour of the more expensive, but equally more effective prismatic telescope. The larger and heavier prismatic telescopes have the advantage of better definition and light gathering power.

A minimum objective diameter of 50 mm may be considered as just barely adequate. One of 60 mm will provide increased optical performance. A large exit pupil, made possible by a large objective lens will permit a large field of view.

A power which is too low will not permit mirage to be seen with any degree of definition. A power which is too high will have a very limited field of view. Variable power telescopes have been made available to the shooter in powers which are useful, but are of much higher cost than fixed powers. Thus while a variable power may enable the shooter to select the best power which may be used on the range under that particular set of conditions, a case can be made for the fixed power.

It can be stated that with a fixed power, one is better able to estimate and compare mirage images over a period of time. Historically a fixed 20 power spotting scope has proven to be entirely adequate over the ranges 300 yards to 1000 yards. An eyepiece set at 45 degrees will permit observation through the scope with minimum disturbance to the shooting position. This last factor becomes a major consideration in the use of the scope on the range.

Telescopes suitable for use on the range can be obtained from a variety of sources. The Bushnell Sentry and Spacemaster are both cost-effective purchases, however neither is presently available with a 45 degree eyepiece. A number of scopes are available from Champion's Choice, 201 International Blvd., LaVergne, TN, 37086. These include the top of the line Kowa TSN series, which has in addition to a 45 degree eyepiece, a 77 mm objective.

The spotting scope is not complete without a suitable stand. It must be ruggedly constructed, and most importantly, it must be capable of being trained easily upon the target and remain that way in stable position. The last item needed on the firing point is an unstable and wobbly stand which is in imminent danger of collapsing during a competitive string.

The minimum stand considered should be the shooter's tripod, available from a number of suppliers. A tripod normally used in photography is not acceptable in this application.

An even better choice is that of a shooter's bipod, or scope stand, the model EKL, from Champion's Choice, or the "Close-up" bipod stand by Parker Hale, available from G. E. Fulton & Son, Bisley Camp, Surrey, England. The now-discontinued Freeland Olympic and Regal bipods were emminently useful in this regard. The bipods, of whatever make, permit the scope to be located closer to the shooter without interference from the tripod legs.

Using the Scope

The spotting scope is normally set up to the shooter's left side, assuming a right handed shooter. It is set in such a manner that the target and its number can be observed through the scope with a minimum of disturbance to the shooting position. After a shot, and the marker's indication of that shot, the shooter may observe the location of the bullet strike on the target. But the proper use of the spotting scope is much more than that.

The lights were turned on for me and I learned a much-needed lesson the day I kept score for a Master class shooter, and a member of the Canadian Bisley Team. His name was Captain T. F. I. Vamplew.

It happened during the Annual Matches of the Ontario Provincial Rifle Association, held at Winona Ranges, just east of Hamilton, Ontario. Match rules had recently been changed that year to allow the use of the newly adopted 7.62 N in competition. Instead of becoming part of a two or three man squad on the firing point, Capt. Vamplew, or Tommy, as he was known on the range, ended up on a 600 yard firing point by himself. Since I had just fired on the previous relay, with a particularly lousy score, I was free to volunteer to keep score for him. And in spite of it being a regular provincial match, Tommy took it upon himself to teach me, a beginning shooter, how to set the scope, how to read mirage, and how to adjust the sight as a result of conditions. He kept a running commentary on what he was doing, and what sight changes he had made. I could observe the results of those sight changes on the target while keeping score for him, and I could also see the same images in my scope that he was seeing. And so I followed his commentary faithfully.

The shooter must first of all set the focus of the scope at a point 60% of the range. The scope is aimed at a point between the 300 and 400 yard ranges, and focussed there for sharpest image. The target at 600 yards will then be slightly out of focus, but still sufficiently clear to see the location of the spotting disc showing the location of the bullet strike and the value indicator. But the most important part of all is the fact that the shooter can now see the condition of the air through which the bullet will pass.

Rifleman's mirage is not mirage at all,

Continued on next page

FROM FULTON OF BISLEY

CATALOG EDITION No. 70

G. E. FULTON & Son Bisley Camp Surrey

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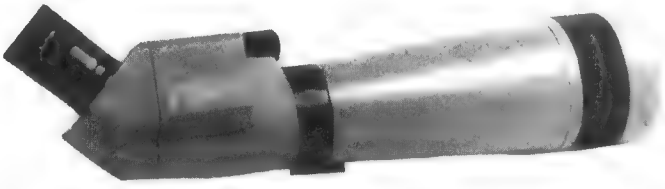

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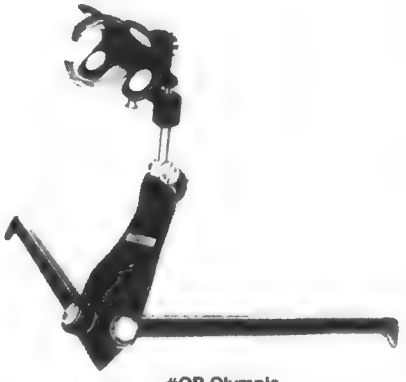

#OB Olympic Freeland Bipod With Saddle

Selecting & Using Spotting Telescopes

Continued

in the classical sense of seeing non-existent distant palm trees in the desert. It is rather the air close to the ground which is heated by the sun's radiation, and which is now rising since it is warmer than the air immediately above it. The resultant mirage, or heat waves, can be observed through the scope. As this heated air rises, it can be deflected from one side or to the other by the presence of other air motion, or wind. It is the height and velocity of wave motion as well as their direction which can be used to estimate the velocity of the wind, and consequently the amount of windage correction to be placed on the rear sight.

Mirage is separated into five categories, indicating wind intensities and resultant sight corrections. These are as follows:

1. Boiling. Waves rising vertically upward. No wind, however sights may have to be lowered.

2. Drifting. Waves of large amplitude, moving across and slightly upward in the direction of flow. Indicative of wind velocity up to 2 mi./hr.

3. Flowing. Waves of medium amplitude, moving horizontally in the direction of wind. Indicative of wind velocity of 2 - 4 mi./hr.

4. Running. Waves of low amplitude, moving horizontally in the direction of wind. Indicative of wind velocity of 4-6 mi./hr.

5. Streaming. Waves of very low amplitude, just barely discernable, moving horizontally in the direction of wind. Indicative of wind velocity of 6-8 mi./hr.

When the velocity of the wind is estimated, from observation of mirage using the spotting scope, the shooter must then refer to tables showing wind corrections for wind velocity and range. These are normally brought to the firing point by the shooter, and are determined by calculation for wind deflection for each calibre.

Capt. Vamplew dropped two points on the day I scored for him, and each time it was due to insufficient sight adjustment. A boiling mirage, for which he kept elevation constant on the sight, caused one shot to strike just outside the bull at 12 oclock. Later a gentle breeze coming off Lake Ontario from the left, which through the scope appeared to be a running mirage, was compensated for by Tommy with two minutes left wind on his sight. The bullet struck just outside the bull at 4 oclock. When I gave him his score card for verification and signature, and then to the Range Officer, it was with the realization that Tommy had just taught me the principles of wind judging by the use of mirage. I was most grateful.

Limitations

It should be noted that the information obtained from the spotting scope images are in the form of estimates only. The images, and the wave amplitudes, will vary depending upon a number of factors, such as range temperature, latitude, etc. It is difficult to determine wind velocities above 8 mi./hr. using only mirage. Also, it is found that mirage becomes non-existent during overcast and rain conditions when the sun is obscured.

There was one other condition in recent memory of bright sunlight, and no mirage. It occurred at Camp Borden, Ontario, where long range Palma Matches are generally held in mid-October. On one occasion, during the week preceding the matches, approximately a foot of snow had fallen, covering the range. The match was held in spite of the snow, the shooters simply cleared a spot for shooting by kicking the snow aside in order to assume the prone position. There was absolutely no mirage, in spite of the bright sunlight conditions, since heating of the air did not take place at ground, or snow level.

Conclusions

The use of mirage images as seen through the spotting scope is a useful tool in the estimation of wind velocity. Appropriate adjustments of the rear sight will be indicated by suitable tables, and when carried out properly, will result in highest possible scores.

Although some limitations occur, reading mirage is an extremely useful function. Experience is still the best answer toward obtaining optimum results.

Requiem

Capt. T. F. I. Vamplew, Tommy as we knew him, continued to shoot for a number of years. He introduced his family to the sport of shooting, and his wife Edith, and two sons Pat and Des came to the ranges to shoot with him. Only on one occasion did I hear him gently complain that whenever he updated his equipment, he was required to purchase four identical items.

Tommy was a great shooter, and a great man. He is sorely missed on the range. We are diminished.

Tommy's legacy remains, however, for his two sons, Pat and Des have continued in the shooting sport, and both have done extremely well.

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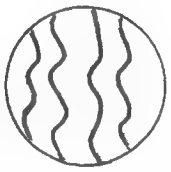


Figure 1. Boiling
Waves rising vertically upward. No wind, however rear sight may require to be lowered.

Figure 2. Drifting
Waves of large amplitude, moving across and slightly upward in the direction of wind. Indicative of wind velocity up to 2 mi/hr.

Figure 3. Flowing
Waves of medium amplitude, moving horizontally in the direction of wind. Indicative of wind velocity of 2 - 4 mi./hr.

Figure 4. Running
Waves of low amplitude, moving horizontally in the direction of wind. Indicative of wind velocity of 4 - 6 mi./hr.

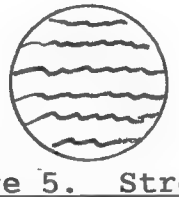
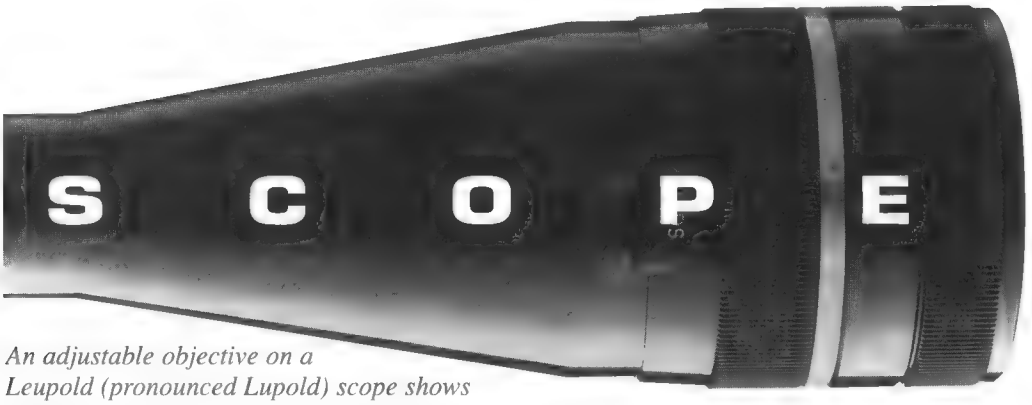


Figure 5. Streaming
Waves of very low amplitude, just barely discernable, moving horizontally in the direction of wind. Indicative of wind velocity of 6 - 8 mi./hr.



SCOPE BASICS

BY DON LEWIS

PHOTOS BY HELEN LEWIS

An adjustable objective on a Leupold (pronounced Lupold) scope shows yardage markings to correct parallax for that yardage. It's wise to remember that the markings are only guides. Focusing precisely requires each shooter to set the objective for his or her eyes.

I can't honestly say that I coined the phrase, "You can't shoot any better than you can see," but I've been saying it in gun articles for over three decades. As we all know, one of the drawbacks in shooting is the rifleman's inability to see the target clearly. To clear up a misunderstanding, especially with older hunters, not seeing the target perfectly is not due to old or weak eyes; it can be vegetation, weather conditions or the haze that settles in late afternoon. These demons are mostly responsible for the users of open or iron sights not seeing the target sharp and clear. I can say unequivocally that there are few times during the fall or winter when conditions are right for a rifle equipped with open sights. Believe me, it's a constant battle, especially when hunting in early morning and late afternoon. These detrimental demons connected with open sights have plagued shooters since the first sights were installed on a shoulder weapon. Various innovations such as the aperture sight (peep) and full buckhorn helped somewhat in the aiming process, but they did little, if anything, to make the target clear and sharp.

With open sights of any type, the target does not appear closer or larger. Since the human eye is unable to focus at the same time on objects at different distance, it must rapidly flick back and forth among the factors involved. With a V-type sighting arrangement, there are three factors – rear sight, front sight and target. The aperture sight eliminates one of these factors – the shooter simply looks through the hole without focusing on it – but there are still two focal points, and the eye is hindered by the focusing problem.

It may appear that I'm totally against the iron sight, but that's not the case. Today's rifle builders don't put much emphasis on open sights since they feel a scope will eventually be installed, But this does not mean that many hunters prefer scopes over open sights. Fortunately companies such as Lyman, Millett and Williams still provide high quality adjustable open sights for rifles and handguns. There's no doubt in my mind that a scope is still a superior aiming device, but many hunters, including the silvered-haired group, can really shoot well with open sights, and here's an example to prove my point.

An aged hunter brought a new Model 70 Winchester 30-06 for me to sight in. He assured me he would be back after the buck season to have a scope installed. I was pretty proud that the last two of my six shots touched the right side of a 4-inch bullseye that also had a one-inch white aiming square in its middle. When the old fellow asked to take a shot or two, I obliged, after assuring him I had done a pretty decent sight-in job. I figured he would be fortunate to stay in the 18 x 22-inch window in the target house.

I watched through a spotting scope, wondering all the time how much wood would be blown off the window edges, but my fears never reach fruition. His first shot touched my last shot, and his second nearly made a clover leaf. He asked me if I could the adjustment just a "bit" to the left so he would be in dead center. I was silent as a week-old mushroom. I made slight correction and watched in admiration as the elderly shooter fired two shots – neither more than a half inch from the one-inch white square.

He thanked me profusely for sighting in his rifle, and you know in advance that I refused the $5 he offered. When I asked

The Lyman Super Targetspot was a favorite of both varmint hunters and competitive shooters during the 1930/40s.

Veteran Pennsylvania deer hunter, Bill Nichols, has his custom 257 Roberts topped with a 2 1/2 x 7X Redfield. This is an ideal power setup for woods shooting.

Bob Bell (Left), Editor-in-Chief of HANDLOADER'S DIGEST holds power switch for the Autauga HAKKO 3 x 12X scope on Lewis's Thompson TCR 22-250 heavy barrel.

him why he wanted a scope when he could shoot like that with open sights, he replied the rifle was not for him, but for his grandson, who would get the rifle as a birthday gift after the buck season. It seemed the grandson was going to be 16 on the same day the old fellow turned 79. That revelation put my left foot farther under my lower denture. I vowed never again to let silver hair and stooped shoulders make me think of poor shooting or aging eyes. The old gentleman could really shoot.

While the iron sight has a long and prestigious career in all fields of shooting, it is not the best hunting sight. That statement may start the adrenaline flowing in many hunters, but it happens to be true. As I pointed out earlier, a hunter can't shoot any better than he or she can see. No hunter sees better with an open sight arrangement. A scope does improve a shooter's vision and shows a sharper and brighter image of the target.

Forty years ago, it was not uncommon to hear a hunter say, "Anybody can hit with a scope." They pushed their philosophy further by saying that using a scope was unfair to an animal. This may sound like I'm trying to build a case for the scope, but since I was told this during the time I operated a scope mounting/sight-in shop, I know it to be true. The strange part of it is, it's a hundred and eighty degrees from being true.

When a hunter aims at a live target, the desired result is a clean kill. Why would a shot be fired if that weren't the case? Looking at this logically shows that the more precisely a hunter can aim, the greater chance for success. In other words, the scope enhances the chances for a clean kill instead of taking advantage of the animal.

Even today, there's a segment of hunters who claim the scope should be used only after the eyes have dimmed and glasses or contacts are needed. One hunter who thought scopes should be banned told me emphatically, "The day I need a scope is the day I stop hunting." A pretty emphatic statement, wouldn't you say? However, he defeated his own argument when he put on glasses to check a ballistic page in a reloading manual. By his own logic, he should have stopped reading when he needed glasses. The scope is not for the elderly or weak eyes; it's a high quality aiming device that enhances a shooter's or hunter's success ratio.

I've already discussed some aspects of iron or open sights. Now might be a good time to bring to light some facts about the scope and its advantages. With open sights, the target never appears closer and the eye's resolving power is greatly impaired. This is not the case with a scope, but first we have to deal with the term "resolving" power. I've used an illustration many times that says a hawk can see a mouse a hundred yards below. It's also possible most people could see a mouse at a hundred yards, but unlike the hawk, they see only a moving object. The hawk sees a mouse, and that's resolving power.

The scope offers resolving power far beyond the limits of the naked eye. Also, resolving power is more than just identifying the target. When a shooter, especially a hunter, sees the target and its surrounding area clearly through a scope, it allows the shooter to separate the target from other similar objects around it. A woodchuck hunting pal, who was dead set against using scopes or even a binocular for any type of hunting, proved this point emphatically when he fired two shots across a wide ravine at what he thought was a chuck's head.

I watched from the edge of a hayfield, and when I recognized my friend through my binocular, I ambled over to see how he was making out. I was still over a hundred yards from him when he motioned for me to stop. In a matter of seconds, he cut the third shot loose. He waved for me to continue. When I got there, he explained he had fired at a chuck's head, but he was puzzled as to how he had missed two shots. After staring across the ravine, he said the third shot must have missed since the head was still visible.

When I looked across the 150 yard expanse, my 8X Zeiss binocular revealed only a tuft of grass on top of a small dirt pile. He got pretty vehement when I told him he was not shooting at a chuck, but at a tuft of grass. He was so upset, he refused to look through my binocular and still stuck to his story that he had fired at a chuck's head. He finally agreed to check out the shots. Just as I expected, he'd shot at a tuft of grass that had grown on a dirt pile in front of an unused den. I could see evidence that a shot might have

Continued on next page

Scope Basics
Continued

passed through the grass, but I kept that to myself. While we discussed the pros and cons of optics in hunting, I emphasized the safety factor in using optics, especially a binocular for identifying the target. During the half hour discussion, he nailed two chucks beyond the 200–yard mark with my heavy barrel 220 Swift that was topped with a 10X Unertl Ultra Varmint scope. He left the field with a new attitude about using optics for hunting.

For some reason, many of today's hunters believe the scope is a modern invention—something that came about after World War I. I don't know the precise date that the scope was invented, but firearms history claims that Sir Isaac Newton (1642-1727) of law of gravity fame had some association with a type of optical sight. That suggests long range shooters were tinkering with the optical sight almost three centuries ago.

We also know that in 1200 (thirteenth century), scientists were experimenting with magnifying lenses. Around 1610, the Italian astronomer Galileo entered the picture, and his work with his telescopes brought him fame which remains to this day. Galileo's telescopes were low in power, and his most powerful telescope magnified thirty threes times and its field of view was roughly one–quarter of the moon. I wonder what Galileo would think if he could look through the 8 x 32X Burris scope on a Dumoulin 22-250 I recently had rechambered to a 22-250 Ackley Improved? These early telescopes had many problems such as seeing the object upside down and reversed left to right. Looking at a celestial object wouldn't be much of a problem, but imagine shooting at a deer that is running upside down. In a riflescope, the erecting lenses reverse the reversed image and form a normal one.

To understand a scope, it's almost imperative to know something about its construction and how it works. We are aware that a riflescope creates an enlarged and bright image of superior detail and contrast. The scope also provides a mechanism that gives the shooter an easily adjustable aiming point (reticle). So, along with an excellent, detailed image of the target, the rifle shooter can adjust a scope to put a bullet in a predetermined area at various ranges

There are four basic elements in a rifle scope: front lens (objective) reticle, erecting system and the eyepiece. In Bob Bell's DBI book, SCOPES & MOUNTS, he says, "These (field lenses) modify the paths of light rays passing through the scope and affect the field of view."

"Some makers install one field lens ahead of the erectors, another one behind them, the location in each case being just forward of the image plane. These lenses project the aperture of the previous lens (the objective or the second erector) upon the aperture of the following lens. The one ahead of the first focal plane, sometimes called a 'collector' lens, is an objective–modifier. It shortens the focal length of the objective lens and thus reduces the overall length of the scope."

I think it's worth discussing parallax. In the 1950s and ps, parallax was considered by many shooters to be the reason they missed everything from deer to woodchucks. It was the subject of many pot–bellied stove discussions. Parallax is really no problem. It really doesn't exist if the aiming eye is always precisely aligned with the optical axis of the scope. Parallax is more like to occur when the rifle is thrown to the shoulder and fired rapidly.

Parallax in a scope can be defined as the apparent movement in the inter-relationship of the reticle and the visual image when the aiming eye is moved at any angle while the scope is motionless. It occurs because the reticle is not positioned exactly on either focal plane. It could be so located if all shooting were done at one range. It would just be a matter of focusing a scope for that range and installing the reticle where the image was formed. In hunting, all shooting is not done at one range. Since the reticle's position is fixed, the image is formed slightly ahead of or behind it. If the aiming eye is then moved slightly, the different distances to the reticle and the image create a tiny angle which seems to make the reticle move. Parallax can be eliminated by focusing the scope precisely for any given range.

To bring this to a close, parallax is not a problem for the hunter, and competitive shooters normally use scopes that have an adjustable objective lens which allows them to precisely focus for the range they are shooting. It was a good alibi for years, but we know now parallax is not the demon it was supposed to be.

A scope must be mounted properly for the user. The photo shows how a scope should be mounted. The ocular lens (eyepiece) must be at least two inches behind the face of the trigger — almost in alignment with the pistol grip. When the shooter's face is comfortably placed on the stock's comb, the eye will see instantly through the scope.

There should be no hunching forward to get the correct eye relief. Note that there is adequate eye relief — the distance from the eye to the ocular lens. The scope should be mounted as low as possible. Note firm cheek pressure and deep reach in the trigger. Downward slope of the stock will slide stock under shooter's face — not up against it.

At this point, I will move away from the internal makeup of a riflescope. I think it's obvious that the modern rifle scope is a precision made instrument. Bell goes into detail about the construction of scope, but the thrust of this article is not how a scope is made, but about its benefits to rifle shooters. To successfully use an automobile, the driver doesn't have to know the internal make up of the engine and all the other components. It's more important that the driver understands how to use the car in an efficient manner that will prolong the life of the car.

For many years, hunters firmly believed that a scope was fragile and prone to failure under normal hunting conditions. It's true that the scopes of the 1930s and 40s fogged under certain weather conditions, and some of them literally came apart due to heavy recoil. I had one scope that had a reticle problem. I used this scope for range testing. As I was firing a series of accuracy tests with a powerful magnum, the reticle began to turn. At first, I thought the scope was turning in the mounting rings, but when that assumption proved false, I realized the reticle was turning. A half dozen more shots made the reticle look like an X. I retired the scope, but did eventually learn that the reticle ring (holder) probably was screwed into the tube. Apparently, the locking material failed and allowed the reticle ring to turn.

Today's scope sight incorporates a mechanical ruggedness that guarantees it will stand up under all regular use, as well as unavoidable accident and abuse. In hunting, the scope must be ready under all types of weather conditions when the shot appears. If it isn't, it's worse than useless to the hunter. To come to grips with this, the scope has to be a precision instrument just the same as any laboratory or scientific optical instrument. Unlike a laboratory optical instrument, a scope must be built to equally exacting standards of optical precision – while standing up to extremes of mechanical shock and changing weather conditions.

The belief that even a minor bump or jar will knock a scope out of alignment is completely false. A scope is designed to withstand the repeated recoil shock of powerful ammunition, as well as all the bumps and jars of normal handling. In most cases, a scope will withstand even the severe shock of being dropped on rocks, and I have a first–hand experience in this type of situation.

Some years back, I was watching a woodchuck's den on an abandoned surface (strip) mine. My unloaded rifle was leaning against a stake–type rest at the crest of a very steep spoil pile. I don't know the degree of angle, but it was literally straight down. As I was getting into position, I knocked the rifle off the rest and watched in dismay (maybe horror) as it bounced and banged its way over half way down the hill before sliding to a stop.

Author firing from his inside benchrest. 100 yard targets are controlled by switches on rear of bench. Lewis is firing a Peightal Custom 6mm BR Remington topped with a 30mm (tube diameter) 3 x 12X Redfield Ultimate Illuminator mounted on S & K Mounts using S & K 3/8-inch risers to get the large objective lens above the non-taper barrel. Note scope is pulled back to put eyepiece (ocular lens) the correct distance from the shooter's eye.

After I managed to retrieve the rifle, which took about a half hour of gingerly working my way to it, I was relieved to see that the scope was not broken or bent. I was sure it was out of alignment, and left the area immediately. A thorough check of the rifle back at my gunshop proved the barrel was straight and the stock was not cracked and the it was in good shape mechanically. The next test would be to see if the scope had suffered internal damage.

I opened the shooting window, stuffed several rounds in the magazine, and fired at the 100–yard target. The first shot was about one inch above the center of the bullseye. The next two shot formed a cloverleaf that measured slightly below one inch between the two widest shots. A half hour later, I was back on the spoil pile, but this time I placed the 22-250 on a soft gun case well back from the crest of the hill.

Ruggedness in a scope depends on several factors. and the main one is not that the optical components must be assembled in a super-heavy steel tube There's more to ruggedness than that. It's obvious that tube metals of high strength that are reasonably lightweight must be used, but it's just as obvious that the components be installed in such a manner that they can withstand recoil shock and other types of abuses.

The answer seems simple – mount everything in some type of cushioning material. This would allow the lenses to ride in a soft environment. Simple as it sounds, it's not the answer. It may be a short-term answer, but after repeated poundings, the cushioning material compresses which allows the lenses to move slightly. Optical engineers claim the slightest tip of any optical element will degrade optical performance and eventually alter line of sight. In a short period of time, this type of setup will turn what was meant to be a high quality scope into one that is virtually useless.

The main thrust is to mount the lenses rigidly between metal surfaces that prevents them from moving when the scope is subjected to normal field use including even what might be termed "severe" shock. Temperature changes can play havoc inside the scope sight. With the failure potential high in a riflescope, it's common sense that to produce a high quality scope requires a high degree of skill, top grade components and high

Continued on next page

Scope Basics *Continued*

precision in the manufacturing process. When all this is done correctly, the scope sight is not just an optical aiming device but a high grade precision instrument.

For decades, the Achilles heel of a scope was fogging, and I must confess that it was a serious problem. Imagine the frustration of a hunter who failed to get a shot at a trophy buck (in fact any buck) because his scope fogged. Back in those days, some of the seals and cements used just didn't hold up. Expansion and contraction due to weather changes broke the seals and allowed moist air to enter the scope.

A substance known as Canada balsam was used to cement lenses together because it has the proper characteristics of adhesion and transparency. It works fine in many optical instruments, but balsam is subject to failure from shock, weather changes and old age. During the World War II years, a synthetic resin was developed. It has the good qualities of balsam and it also withstands severe changes in weather conditions. It is also capable of withstanding mechanical shock.

Today's rifle scopes are fogproof. This means they can are literally waterproof unless subjected to deep water where the pressure is great. The belief, and this was common a few years ago, that scope filled with nitrogen were guaranteed to be fogproof. The truth is that as long as the nitrogen or any other type of dead gas remains in the scope, it will not fog. But when a seal is broken, the nitrogen escapes and moist air enters the scope. As you can see, it is not the nitrogen that keeps a scope fogproof but the seals and cements that keeps the nitrogen from escaping.

Up to now, this article has been intended to give some background on scopes. However, I have learned from hundreds of letters that most shooters are also interested in which scope is best for them. This is a more complex question than meets the eye, but there are certain criteria to follow.

Is there such a things as "the best scope on the market?" My answer may start table-pounding arguments, but the answer is an emphatic "No". Stop and think for a minute about other products. Is there a "best car" or "best TV" or really best anything? A friend paid close to $5,000.00 for a powerful riding lawn mower. He didn't want anything but the best. His neighbor purchased a slightly smaller unit at a discount store for well under $1,200.00. My friend chuckled at his neighbor's lack of wisdom. His laughter was short-lived when he had to borrow the discount job not once but twice.

I'm not implying that inexpensive scopes are just as reliable and have the same quality that the more expensive ones have. After forty years of range testing, I'm convinced that you get what you pay for in hunting optics. I am still using several Unertl varmint and target scopes that were purchase in the early 1950s.

To start with, don't be swayed by the initial cost. After a few years of flawless performance, the extra money spent will be forgotten. Don't try to buy a multiple-use scope – one that will take care of any hunting or shooting situation. Scopes like trucks have a specific purpose. A 32X Mitchell is designed primarily for competition. It is not a field scope. On the other hand, an 8 x 32X Burris can be used for both competition and varmint hunting, but it's pretty difficult to have a reticle thickness that gives optimum performance for both situations. I see the Burris more as a hunting scope. It's wide range of powers are ideal for the handloader or varmint shooter. Powers up to 14 are sufficient for field use, and the higher powers up to 32X can be used for range testing handloads and zeroing in.

A common mistake, especially among new scope converts, is to think only in terms of power. Power is essential, but magnification should be matched with the type of use the scope will get. A 4x 12X on a 22 rimfire squirrel rifle will do the job, but, for shots up to 50 yards, a fixed 4X or 6X is a wiser choice.

I like variable power scopes with high magnification since I do more range work than field shooting. Scopes such as the Burris 8 x 32X, Simmons 6 x 20X, Nightforce 5 x 22X, Sightron 4 x 16X or Weaver 6 x 24X are ideal choices for even the most demanding varmint/handloading hunter. I'm sure they could be used on big game rifles, but a wiser choice would be the Zeiss 3 x 9X, Weaver 3 x 9X, Tasco 2 1/2 x 10X or a Simmons 1 1/2 x 5X.

Not everyone will agree, but a fixed 4 power is adequate for most hunting situations. Probably, the 2 x 7X variable or at least the 3 x 9X represent the best power setup for big game hunting. The scope should remain an aiming device, and regardless of its power, should never be used in place of a binocular for identifying an object to see if it is game. In Pennsylvania's 1996 deer season, I spotted a movement in a stand of pine trees about 75 yards distant. A long look through a compact 7X Bausch & Lomb binocular showed it was a buck deer. When the deer moved into a thinned-out area, I doubled check the rack through a 3 1/2 x 10X Simmons Whitetail Classic. It was legal and fell to a rib cage shot from a Model Seven Remington 7mm-08.

A scope is a lifetime investment. You wear into a scope similar to wearing into a pair of hunting boots. Someone said it takes five years of hunting to prove the quality of a scope. I suspect that's correct since I learned over the years of scope testing that all that's bright is not right. Go for quality since a scope is an extension of a shooter's own eyesight. It allows the shooter to see the target better, and I don't want to be redundant, but you can't shoot any better than you can see.

In this 1972 photo, Lewis points to a Remington 511 Scoremaster 22 rimfire which was his first gift to Helen in 1942. Directly under his index finger is a Savage Model 342 chambered for the 22 Hornet. It is topped with a Saturn Boone Gunscope that boasts 2 1/4X.

FOR WANT OF A BOLT

BY C.B. (MAC) McEOWEN

As a subscriber to Precision Shooting I have read many of the articles on custom made actions and receivers. On the home made, non-production side I have only seen one that tackled the construction of the bolt, a 22 rimfire made by Jim Higley, **PS** January 93. I decided to try the project of building the complete receiver and bolt. The receiver was made along the lines of Dr. Erickson's design, **PS** December 95, with a few changes of my own. I will not elaborate on the construction of the receiver.

I started with the design of the bolt and it's associated parts. The first criteria of the bolt was a wide safety margin and the second was the use of as much commonly available material as possible. A cartridge on the shorter side was desired so I used the 7.62 x 39 as the design cartridge.

The bolt body was constructed from a Grade 8 bolt. The choice of this material came from experience and the consultation of different reference materials. To leave nothing to chance a sample of this material was tensile and hardness tested, a summary of the testing is given at the end of this article.

The striker was constructed from a Grade 5 bolt using a shortened Ruger M77 striker spring and a cocking piece made from Grade 8 scrap.

The bolt shroud was the only part that was "mystery meat", probably some sort of cold rolled steel. The bolt handle was an after market item modified to the small diameter of the bolt with a spacer used for the root of the bolt handle.

The construction of the bolt was completed with a lathe, mill-drill and common cutters no carbide tooling was used. The only tool used of a special nature was a dividing head to position the bolt head and shroud to cut the lug sides and necessary arc segments between the lugs or resulting flats on the bolt shroud.

The bolt constructed was a twin lug forward locking device designed for right-handed right port operation. The bolt body/head was designed as an integral single piece. The intent of the article is the overall construction not the construction of a specific bolt, therefore dimensions are not included.

CONSTRUCTION PROCEDURES

Make the bolt body/head first. Face off the head end of the tested Grade 8 bolt and turn the flats on the head to about .010 over the designed diameter of the locking lugs.

Measure from the small end to about 1/2 inch from what will be the lug face and mark. Measuring from the small end, note the length to the mark and to the lug face. Drill out the bolt body from the small end to the mark noted using the tap size drill for the threads to be used on the bolt shroud. Remove the large drill and use a bit the size of the striker's minor thread diameter to continue to the depth of the lug face. Using the tailstock as a tap guide, thread the end of the bolt body to the size and depth that will be required for the bolt shroud. Cut the bolt body section to length and square it up. Center drill or turn the required angle on the inside of the edge to use a live center for finish cutting.

Chuck the bolt body by the large head end supporting the small end by the tailstock. Turn the bolt body to the desired finished diameter, square up the bolt head with the length of the bolt on what will be the lug faces. The body of the bolt should now trued up with the inside.

Use a piece of scrap material 5 or 6 inches long and turn it to the same outside diameter as the bolt body, drill full length to the tap size used for the bolt shroud threads. Square up both ends and tap one end for the bolt shroud, use the tailstosk as a guide for the tap. This piece of material will be used to setup the dividing head for cutting the bolt lugs and arc segments on the bolt head and shroud. Accuracy is very important.

Chuck the material to be used for the bolt shroud and turn to the outside diameter desired. (I turned mine to the same size as the finished bolt lug diameter.) While the work is still in the lathe, turn the small section of the shroud that will thread into the bolt body to the appropriate diameter and length. Thread the small portion of the shroud using single point threading or a die supported with the tailstock. Relieve the face of the threaded section about one turn and check fit with the bolt body and the setup piece, the fit should be flush. Drill the shroud full length to the desired striker diameter. Cut the shroud to the length desired. Screw the shroud into the setup piece and chuck in the lathe with the large end toward the tailstock, face off the shroud and drill for the cocking piece. Be sure to leave an adequate shoulder on the inside of the shroud for the cocking piece body to abut against, as this shoulder holds the whole thing together and stops the fall of the striker.

Use a piece of Grade 8 scrap to turn and polish the cocking piece body to the appropriate diameter to fit the shroud. The fit should let the piece move freely without binding or undue play. Drill and tap the cocking piece body all the way through to the size that will be used to attach the striker. Use square stock to make up the cocking piece. Make the cocking piece as long as is needed to give

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For Want of a Bolt

Continued

at least .200 striker fall plus a little for adjustments if needed.

Line up the dividing head square to the milling machine table so the axial length of the bolt body will be parallel with the X axis of the machine. Chuck and indicate true the setup piece. Locate the center line on the setup piece and note the reading on the Y axis. Install the cutter that will be used to cut the lugs and adjust to just touch the top of the test piece, note the readings on the Z axis, this will be the upper most position of the quill.

Calculate the depth of cut needed to form the lug sides by subtracting the designed lug width from the bolt body diameter and dividing by two. Move the mill table so the test piece is to one side of the cutter and drop the quill to the depth required to form the lug side and note the reading of the Z axis, this will be the lower most position of the quill. If your machinery has the capability to lock in the movement of the quill to upper and lower limits, set the locks. Carefully move the table so the cutter just touches the setup piece and make a note of the reading on the Y axis. Repeat the last step on the opposite side and note the reading. Remove the setup piece and chuck the bolt body on the small diameter and indicate it true. Leave enough room for the cutter to clear the dividing head but make a full cut the length of the bolt lug sides on the bolt head.

With the measurements taken and the bolt trued up in the dividing head make sure that everything is correct. Return the quill to the upper most position and cut the excess material from what will be the bolt head. If things were setup right you should have a large flat that joins with the bolt body. Rotate the dividing head 180 degrees and repeat the operation. See photo # 1.

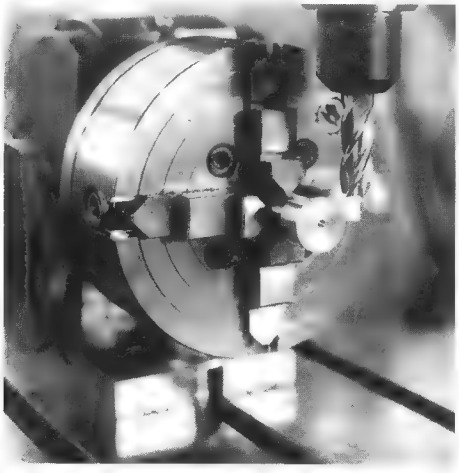


Photo #1

Move the table to the noted position to cut the bolt lug side and drop the quill to the determined depth. Cut the flat side of the first bolt lug. Move the table to the position noted for the opposite lug and repeat the operation. Rotate the dividing head 180 degrees and repeat the operation. When completed the bolt head should look like a large cross. See photo # 2.

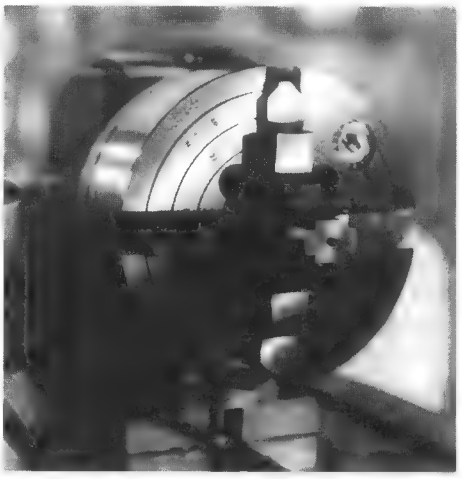


Photo #2

Return the table to the center position and the quill to the upper most position used to cut the flats in the first cutting operation. Adjust the table position so that one edge of the cutter is on the center line. From this position the arc segments can be cut for the two opposite bolt lugs. Make a cut along the axial length of the bolt head then rotate the dividing head 1 or 2 degrees toward the cutter edge and repeat until the arc intersects with the root edge of the lug, but don't under cut the lug. Rotate the dividing head 180 degrees and repeat the operation for the opposite lug. Reset the table so the cutters opposite edge is on the center line, and complete the bolt lug cutting operations. See photos # 3 & 4.

Screw the bolt shroud onto the threaded end of the test piece and secure it in place with the cocking piece body and a through bolt. Remove the bolt head and reinstall the test piece with the shroud into the dividing head and indicate true. Reposition the table to and cut the large flat on what will be the bottom of the shroud. After cutting the flat remove the cutter and install the cutter to cut the cocking piece slot, I used a 1/4 inch. Reposition to the center line and adjust the quill to make a cut that will leave a flat and small edges on the cocking piece body. Cut the cocking piece slot the length of the bolt shroud and the threaded section plus the length that the nose of the cocking piece may extend beyond the threaded section. Position and clamp the cocking piece into the slot and drill, tap and counter bore for attachment screws. After the above operations the original cutter may be replaced and the shroud positioned and rotated to cut the arc segments needed on the bottom of the shroud to clear the raceways and cylindrical section of the receiver. The shroud may now be moved to cut to the desired shape. (I shaped mine similar to the bolt head so it would fit into the receiver raceway on one side). See photos # 5 & 6.

Screw the shroud into the bolt body and note the position where it stops. If

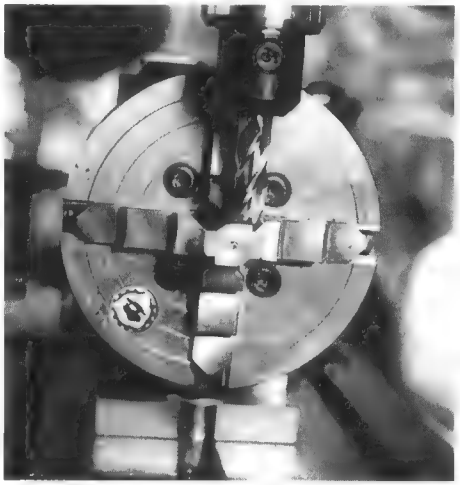
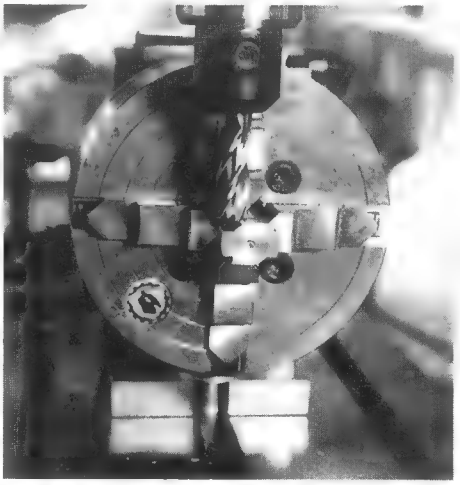


Photo #3



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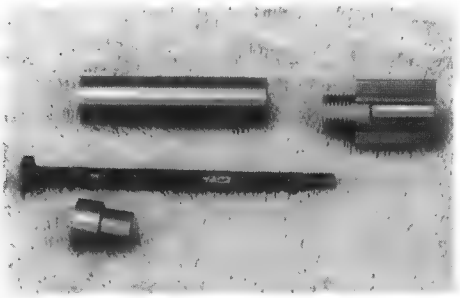

Photo #5

Photo #6

the bottom flats on the shroud do not aline with the lugs when fully seated carefully face off the bolt body or threaded face until the flats will line up. The position of the flats and slot on the bottom of the shroud, when full seated, determine what will be top, bottom, left and right. The positioning of the bolt handle, ejector and extractor depend upon the position of the bolt shroud when the bolt is in the locked position.

The cocking piece and body can be assembled and the shape of the nose ground as desired, about 30 degrees works well.

Chuck the bolt in the lathe by the body section. Square the bolt face and turn the bolt lug section to finished diameter. Use a #1 center drill and drill the bolt face just deep enough to start the 60 degree center angle. Use a #45 drill, continue the drilling of the striker pin hole through the bolt head to intersect with the internal hole previously drilled. Mark the face of the bolt at the edge of cartridge case diameter, this will locate the position for the drilling of the ejector pin hole in a later step.

The bolt is again chucked in the dividing head and trued up with the completed lugs facing the cutter for the extractor cut. (I used a flat extractor similar to a sako about 3/16 inch wide.) Move the mill table and rotate the bolt with the dividing head to position the cut for the extractor next to the appropriate lug. Mill the cut deep enough to clear the thickness of the material used. At the rear of the recess plunge cut a small amount to form a recess for the heel of the extractor. The extractor is held in position with a small screw that has a taped hole in the heel recess. See photo # 7.

The bolt body can now be drilled for the ejector pin and spring. Locate the position of the ejector pin and line up the drill on the mark for the cartridge edge. Drill the hole to the desired diameter, 1/8 inch will do, and to a depth just short of the shoulder left in the bolt body by drilling. Don't drill through the shoulder the spring needs a seat. Replace the bolt body in the lathe chuck and cut the cartridge head recess to a depth that will just cover the cannelure of the cartridge, typically .125 inch. Make sure that the cartridge head will fit without binding and with just a little clearance.

Use a piece of drill rod to fashion a ejector pin. Fit the pin and a spring into the hole so the whole thing can be compressed flush with the bolt face. Use a dummy cartridge hooked under the extractor to push the pin into the hole as a test.

Set the bolt body up in the dividing head and rotate it until the bolt lugs are positioned horizontally and the ejector pin hole is on the upper side. Chuck up the drill that will be used for the retainer pin and position the drill to cut through the edge of the ejector pin hole. This location can be measured or it can be "eyeballed" using the pin hole for the guide point. Move the table to the location for drilling. Locate the position of the ejector pin retainer, which should be about half way between the forward edge of the bolt and the internal shoulder. Plug the ejector pin hole with a piece of scrap that fits snug and past the location of the retainer hole, leave enough exposed to get hold of after drilling. The retainer hole can be hard to start because it must start on an angle. Use a small milling cutter slightly larger than the desired hole and carefully plunge cut a small flat to start on. Drill the retainer pin hole all the way through, the plug will keep the bit from bending.

Remove the plug and use the dummy cartridge hooked under the extractor to push the pin and spring into the hole. Hold the compressed ejector and spring in the hole with a small scribe mark the

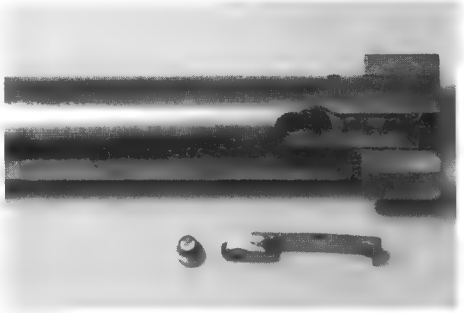

Photo #7

ejector. The mark will be the forward most position of the flat needed to allow movement of the ejector pin.

File a small flat on the side of the pin to allow enough movement to push the cartridge free and for the pin to be fully compressed into the bolt. Test the freedom of movement of the ejector pin under load to assure that the retaining pin will hold the pin but not interfere with the function.

When the shroud and cocking piece are built the position of the bolt handle can be determined and the bolt handle attached. Make a small root for the bolt handle that matches the contour of the bolt body then attach the bolt handle to the root. See photo # 8. The proper positioning of the bolt handle root is critical to the operation of the bolt in the receiver, check the setup before making it permanent. Screw the shroud fully into the bolt body, the flats on the bottom of the shroud should be horizontally lined up with the lugs. Looking at the top of and holding the shroud, with the flats on the bottom horizontal, rotate the bolt body 90 degrees clockwise until the locking lugs are in the upright vertical locked position. Locate and mark the position for the root of the bolt handle. After checking the position-

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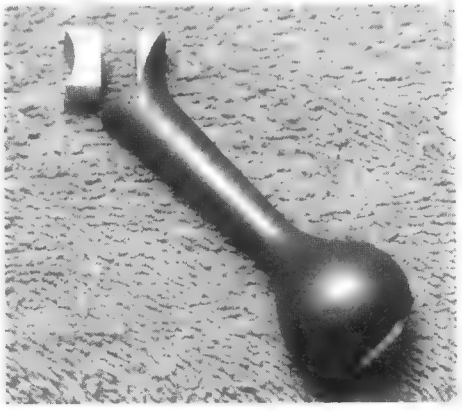

Photo #8

For Want of a Bolt
Continued

ing attach the root for the bolt handle. If everything is correct the bolt handle root will be in the upright vertical position when the lugs are in the horizontal or open position. The bolt handle can now be attached. An after market handle from Brownell's was used. Silver brazing was used to attach both the root and handle.

The cocking cam edges are located and marked using the bolt shroud slot as a guide. Screw the bolt shroud into position on the bolt body. Using the bolt shroud for the guide position the bolt upside down into what would be the locked or position. The left hand edge of the slot cut for the cocking piece will

Photo #9

aline the left, straight, edge of the cutout that forms the cocking notch in the bolt body. See photo # 9. Keeping the flats on the shroud in the horizontal position rotate the bolt body 90 degrees to the left or what would be the open position. The left edge of the slot for the cocking piece will now locate the *maximum possible* position for the cocking cam angled edge.

With the locations of the cocking cam edges positioned, lay out the guide lines to cut the cam. The straight left edge should be laid out just a bit longer than the strikers full fall. The right edge of the cocking cam should match the angle of that on the cocking piece nose. The cam angle must intersect the end of the bolt body short of the maximum position, which will leave a flat for the cocking piece to rest on when the bolt is in the open position. The flat can be notched slightly if a more positive lock is needed. The cocking cam cutout may be cut and polished with a dremel tool and cutoff disks. With the cam cut, assemble the bolt and shroud to check the movement of the cocking piece to assure that the cocking piece is moving it's full length of fall and stopping against the shoulder in the bolt shroud. See photo # 10.

When the bolt body, shroud and cocking piece are completed the striker can be constructed and fitted. Screw the bolt and bolt shroud together insert the cocking piece and position the assembly in the fired position. Calculate the length of the striker to the forward edge of the shoulder left by the body drilling step to the rear of the cocking piece and note length. This measurement will locate the maximum forward edge of striker spring collar. Calculate the length from the rear of the cocking piece to the end of the striker minor thread diameter hole. This measurement will give the length of the striker's major diameter.

Calculate the length of the striker pin hole that goes through the actual bolt head and add to the above measurements. Add some length to the minor diameter of the striker for the final fit up of the striker.

Use a length of Grade 5 bolt of the appropriate diameter, thread the end to match the threads in the cocking piece. The threaded section should be a few threads longer than the cocking piece body for the purpose adjustment if needed. Don't use the threaded portion of a factory cut bolt, as it more than likely isn't parallel or centered with the shaft of bolt. Chuck the length of material in the lathe and center drill the end that isn't threaded. Move the striker in the chuck and support the end in a live center, leave room to thread and fit the spring collar. Measure the striker and mark the front edge location of the striker spring collar. To cut the threads, turn down the nose of the striker back to the forward spring collar mark so that the die will just slip over this minor diameter then thread the striker about 4 threads to hold a nut. Use a file to turn down the smallest portion of the striker to a slip fit through the striker pin hole in the

Photo #10

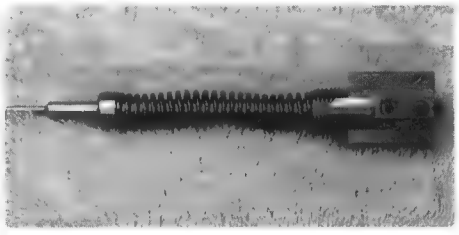

Photo #11

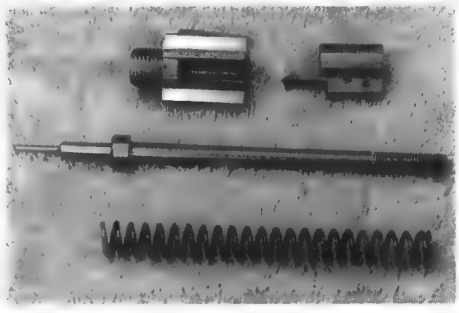

Photo #12

bolt head, leave a radiused shoulder. Screw the spring retainer nut on with a thread locking compound, turn nut down to size after curing. Assemble the parts and check for fit. There will probably be some fitting required to make everything work smoothly, especially under spring tension. See photos # 11 & 12.

After the bolt is fitted to the receiver and the trigger fitted the sear face location can be determined. The cocking piece can be finished by cutting down the forward portion of the cocking piece, leaving the sear face. Finish the striker by adjusting the striker pin protrusion to .050 inches. After the final fitting the cocking piece should have a pin or set screw installed to prevent any movement or unwinding of the striker.

Well that's it, now a receiver is needed. Or see if what was designed will fit that old iron in the shop without the bolt.

As can be seen a bolt has many parts to complete, 16 with pins and screws on the one I put together. Was it all worth it? I thought so. With a little planning and patience the project isn't that complex. See photos # 13 & 14.

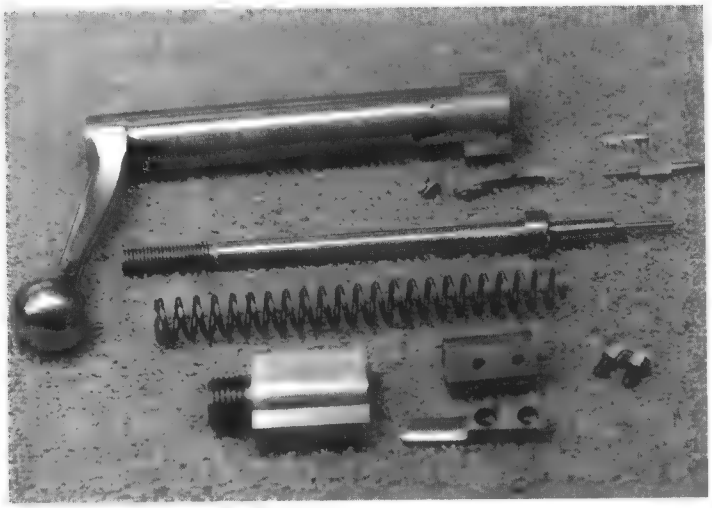

Photo #13

Photo #14

CAUTION

The quality of material used for a breech blocking device is of the upmost importance for the safety of the user. Heat treating may or may not be required to achieve the hardness and tensile strength required of such a device. I can't and won't recommend materials because I have no control over the eventual handling or use. Be SURE of what you have by getting it tested by someone who has the proper testing facilities, experience and equipment. Just because it is marked or advertized as Grade XX doesn't mean that it is – get it tested. If the material must be heat treated after construction, have a qualified heat treating company do the work and get a certification of the hardness after the heat treatment. The material used for this device was TESTED to a tensile strength of over 150000 PSI at a Rockwell "C" scale hardness of 30-32.

TESTING

The testing of the bolt material was carried out by Dave Cox of the Mechanical Engineering Department at Montana State University, Bozeman.

A sample of the bolt body / lug material 0.750 IN. in diameter on the ends, 4 inches in length over all with a turned test section of 2 inches in length and diameter of 0.250 inches was made up. The sample gives a cross section of 0.049 IN. SQR. for testing.

The following summary of results of tensile strength for the bolt body / lug material were obtained by Mr. Cox., using an Instron Corp. Series IX Automated Materials Testing System 1.16.

Test Area (IN. SQR.)	0.049
Spec gauge linear (IN.)	2.00
Grip distance (IN.)	4.00

LOAD AT PEAK (LBS)	STRESS AT PEAK (PSI)	LOAD AT BREAK (LBS)	STRESS AT BREAK (PSI)	STRESS AT 0.2% YIELD (PSI)
8400	171400	7093	144800	161500

Using the above results and Dan Lilja's bolt shear formulas, **PS** June 95, the following approximate actual firing conditions.

BOLT THRUST (LBS)	SHEAR STRENGTH (APPROXIMATE) (LBS)	SHEAR AREA (IN. SQR.)	LUG FLEX (IN.)
5910	29230	0.362	0.0014

The above results indicate a margin of approximately 4.9 to 1 times shear strength to thrust applied. The results obtained estimated a maximum chamber pressure of 55000 PSI, a yield pressure of 161500 PSI (0.2% yield) and a cartridge head area of the 7.62 x 39 case head. Actual firing condition chamber pressures could not be measured.

Further testing the bolt under actual firing conditions, I pulled the string on 150 rounds of 7.62 x 39 123 grain FMJ Lapua ammunition. Other ammunition from the U.S. and the old Soviet Block countries was also fired for a total 200+ rounds. No mechanical problems were encountered and the bolt's function was satisfactory.

After testing the bolt, receiver and barrel were disassembled. All ware and mating surfaces were measured and compared to the unfired measurements. Using my instrumentation I found no measurable changes.

SMALL GROUPS — WITHOUT A BENCH

BY JP O'CONNOR

Having only recently - and I mean very recently - crawled out from under a big rock, I "discovered" PS and immediately ordered a subscription, quite a few back issues, annuals, and other items. The nice ladies in Dave's office were only too happy to accommodate each of my requests for more reading material. My only complaint is that they were also quite adept at ensuring that each request showed up on my credit card. I don't suppose Dave would see a problem with that like I do! Anyway, I noticed that one of the large boxes he sent me had originally been labeled "Cultivated Dandelions". Now I've lived in several parts of the country (Midwest, East, and now the Southeast), and I've never seen anyone actually try to encourage those infernal things to grow, in spite of their frequent success at doing so! What's he doing up there? But I digress...

One of the first topics that caught my eye while studying my newly acquired reading material was the ongoing discussion about shooting very small groups from the prone position. Several years ago, Jack Foster told me that he could shoot better smallbore rifle (.22 LR) groups in prone than from a bench. I didn't quite believe him at the time (foolish youth!), though now with more experience, and having tried both, I see his point. The barrel time of the bullet, and the gun movement during that period, certainly make smallbore quite different from high power shooting. Neither is "easy" though different techniques are required.

Really good smallbore prone shooters talk about consistent performance, follow-through, and wanting to get the gun to have a consistent recoil movement. With smallbore, the shooter can feel the gun move while the bullet is still in the barrel. In high power, the gun is also moving the instant the bullet starts to move. However, by the time the high power shooter actually feels the movement, the bullet is usually already gone. Thus, the smallbore shooter must be especially careful to maintain position until well after the shot. This allows assessment of the gun's movement which helps in calling the shot and in determining if anything was different from previous shots. What is going on with the smallbore rifle and what makes for a small group?

Before answering that, a bit of background is in order. Smallbore prone has been a fun pastime of mine for 25 years, though strictly as a casual pursuit. In the fall of 1995 I decided to get serious. Having previously earned Expert class in outdoor conventional prone under the guidance of friend and coach Tom Suswal, I again turned to him for assistance. Most of 1996 was spent in getting equipment changes and adjustments taken care of while starting to work on technique and the mental aspects of the game. (Work that continues this year.) It quickly became apparent that even the slightest change in position, muscle tension, or pressure on the stock would change the point of impact. I hadn't noticed high power rifles being quite that sensitive. (Maybe I have more to learn there, too!)

I'm not trying to take anything away from high power here. It is a demanding game. Smallbore requires a slightly different technique. Larry Moore told me that 100 yard smallbore is excellent training for 1,000 yard high power. Different, yet similar. The same can be said of smallbore and benchrest. Any good BR-50 shooter can tell you it's not just a matter of plopping a heavy gun on the bench and waiting for the right conditions! Put a smallbore rifle on a couple of sandbags and watch the groups grow! Can you say "washtub"? Good BR-50 shooters rarely use sand and leather; their "rests" are often low friction affairs of steel and plastics such as Delrin. Why? They need consistent gun movement. Their shoulder, cheek, and trigger hand techniques must be consistent as well. Similarly, a high power shooter can't get away with lazy technique.

Can prone groups rival bench groups? I offer in evidence two of my groups shown here. They were fired at the 1996 Blackhawk 3200 prone match on Memorial Day weekend. Tom had insisted that I was ready to start learning how to shoot in the really big matches. This also gave me a chance to see some old friends from the Southwest Ohio Rifle League. So we went. Each group is a perfect 50 with 5x, fired as part of the 50 yard match - with iron sights. No bench; no scope. Just prone with irons. Unfortunately, I let one of my 40 shots leak a couple millimeters out of the 10 ring so I ended up with 399 with 35x. I wish I could say the rest of the weekend was as good as this for me! (I finished fairly high in class, though was no threat for the win.) Are these groups a fluke? Judging by the targets turned in by other competitor's, especially the Master class shooters on the first relay, these kinds of groups aren't all that rare though not exactly typical.

Many of their groups were smaller than mine! I haven't had the ones shown here scored as if they were benchrest targets; they appear to be around the .200 range.

Many high school shooters fire three position air rifle matches. The barrel time of the pellet is even longer than for a smallbore bullet. I have been working

with Luke Shank of Fort Wayne, IN (state high school champion as a sophomore) who is showing a great promise in three position air and smallbore rifle. He is beginning to shoot some incredible prone groups with the air rifle. It doesn't hurt that he started using my old Walther LGR which was used by its previous owner, Jim Meredith, to win several international competitions including the 1983 Pan Am Gold. As any shooter knows though, the gun is just the starting point. Luke is obviously becoming very consistent from shot to shot.

Just what are the ingredients that make small prone groups?

On the technical side: good equipment and compatible ammunition are required. My rifle has headspace somewhere between .0420 and .0425 and the ammunition used had about .041 rim thickness so we didn't adjust my rifle's headspace. This particular lot of Eley Tenex had been selected by Tom several years ago and he used it to earn 4th place in the prone matches at Camp Perry in 1990. My rifle happily digested this same lot so I used it with great results. The vast majority of the rounds in this lot measured about 0.41 and 0.42 rim thickness (only a few were less) and the weight was consistent with just a few tenths of a grain. I believe I could have shot this lot right out of the box (unsorted) without noticing any difference. High power shooters, prone and benchrest alike, know all too well the importance of building ammunition that matches the rifle. Smallbore shooters can't build their rounds so must test different brands and lot numbers to find something their rifle is happy with.

On the performance side: good position, consistent technique, and merciful light and consistent wind conditions (or real good experience at wind shooting!) are critical. Tom had helped me build a solid position and we had worked hard on getting me to deliver each shot exactly the same way. Ensuring that I had a stable natural point of aim was one of the most critical elements. Ensuring that no muscle is involved in holding the gun is another critical aspect. (Really bad pulse bounce often turns out to be a tensed bicep!) I hadn't had time to "mess up" Tom's fine coaching work so it all came together for me in that match. Since then I have had ample opportunity to "break" things! Because the shot delivery was so consistent, the gun recoiled (bounced!?) exactly the same way each time allowing each shot to strike the target in almost the same place. The sling was not outrageously tight, nor did it take a pry bar to get the buttstock on and off my shoulder. A firm position, not a tightly wedged position, is all that it took. Later in the day, as I fatigued, I would fail to notice that a muscle somewhere had tensed up and I would throw a 9. An appropriately planned and followed physical training program can help consistency here! Finally, the wind conditions didn't hurt me too much although I did have to wait a few times for the right condition to come back.

So the secret is that there is no secret! It does not take very hard work and careful attention to the details of shooting performance. One of the best items I've read is Randolph Constantine's article on improving prone skills published in the 1995 PS Annual. High power or smallbore, prone or bench, any shooter can

Continued on next page

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Small Groups Without A Bench

Continued

learn a few things from that article.

Prone shooters as a group have not experienced much with barrel turners since they usually already have a sight base at the end of the barrel. Lately, the "bloop tube" has became popular (even with younger shooters whose eyes don't need the help of getting the front sight farther from the eye) which complicates the equation. Some have noticed the tube has sometimes acted as a type of barrel tuner on its own. My old friend Bruce Buckner's PS article raised my curiosity on the topic of barrel turners. I used to run the stat office for Bruce many years ago when he ran the high power matches at Fairfield Sportman's club outside of Cincinnati. I think he was a bit disappointed when my DCM M1 showed up so I could fire in his matches, though he hid it well! Illegal for UIT competition, turners might prove interesting for conventional prone. (Can anyone picture Frank Boyd rummaging through his "junk" box about now?!)

Now I've done my part to add to the body of rifle accuracy mis-information- and even managed to sneak it past our esteemed editor! The quest for tight groups continues. Speaking of which: Can anyone put 60 consecutive smallbore rounds in a group .600 or smaller at 50 meters? Christian Klees of Germany did it with a sling and iron sights at the 1996 Olympics. The other 7 finalists, including USA's Bill Meek, weren't far behind. Klees then fired 10 more shots in a pressure packed final - in a group measuring less than about .400 - to win the gold. Even both sets of his sighting shots would have been inside the groups.

Oh, one more thing. Could someone please help that nice PS writer from Colorado find his ax? I want him writing more for PS - grinding his ax in print if you will - instead of wandering around his ranch looking for it!

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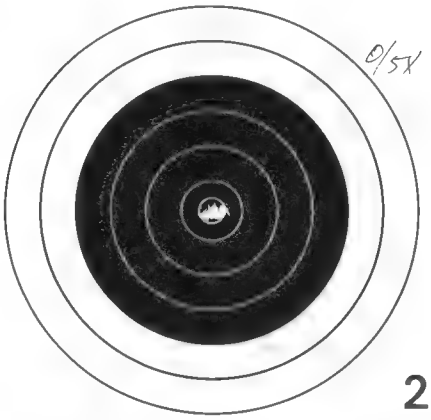

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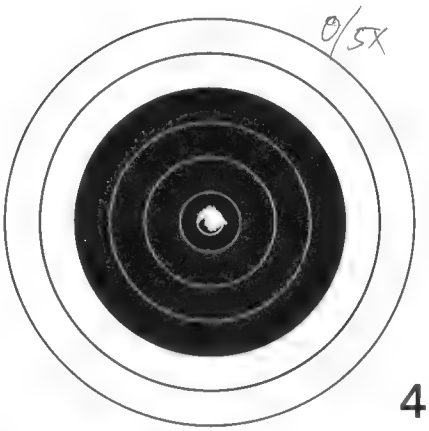

4

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"A COMPETITIVE Combination"

by Grant Pickard

Photos by Jim Ashford

For the last three years we've been searching for a reliable .22 caliber rimfire rifle- a rifle that meets the extreme accuracy requirements of today's benchrest rimfire competition. After exhaustive testing in an indoor facility, it seemed to require the efforts of the best custom gunsmiths, and the finest components available, to assemble a rifle that was competitive. Even with these efforts and a large amount of cash outlay, there seemed to be no assurance that the end product would be satisfactory.

The .22 rimfire being the temperamental creature that it is, had to be carefully fed with the right ammo. There have been many good shooters that have exhausted their favorite lot of ammo and saw their scores drop when they could not replace it with a lot that performed as well in their rifle. This was in spite of the fact that the ammo distributors stated there was no difference in lot numbers. This required constant ongoing testing in search of suitable lots. As soon as new lots were made available, small quantities would be shipped by the most expedient manner. If these lots tested good an order would be placed immediately for as much as the shooter could afford. For most of us this was no small item as good match ammo cost from $500.00 to $800.00 dollars for a case of 5000 rounds. Some of today's shooters will shoot more than two cases in a competition year.

In the past few months we have tested several (at least seven) Anschutz Model 2007 barreled actions that have been married to an aluminum bedding block. These blocks, which have been developed by Speedy Gonzalez, are precisely manufactured on CNC equipment. With these blocks properly set into one of his computer designed graphite stocks, the rifles have consistently produced 5 shot groups that measure in the high .0's and low .1's (.080 to .145). The testing was done indoors at 43 yards on a one piece return to battery rest. This kind of accuracy was achieved with a barrel device from Ron Hoehn called "4000+" that permits adjustments of one thousandth of an inch. This device lets you find the "sweet spot" for a barrel-ammo combination and record the setting for future reference. You may then test other ammo, change the setting if needed, and then return to the original setting, using the micrometer-like markings on the device. I know you have shot groups that were one bullet hole wide but three or more high. This situation seems to beg for some way to change the barrel vibration. Centerfire shooters have the luxury of clicking up or down on their powder measure to compensate for this. Rimfire shooters have the barrel device. I understand this device was named "4000+" because it was designed to aid in shooting a score of 4000 and more on the BR-50 International target. Marion Collier, a many times champion, proved this possible, when he fired a world record score of 4896.0000. He used an Anschutz 2007 set up by Speedy on an early version of the aluminum block. The factory barrel was equipped with "4000+" properly tuned. The stock used was a McMillan BR50 as the new stock design was not available at that time.

The low inline profile and sharp and trued lines of Speedy's new stock design allow the rifle to ride the sandbags extremely well without riding up as in some other designs. These features have already been proven and widely accepted in the centerfire benchrest world. It adapts well to the mechanical rests used in some rimfire competitions. For the first time there seems to be a truly "drop in

Continued on next page

"A Competitive Combination"
Continued

stock". We've had shooters ask us for ways to improve the consistency in accuracy in the Anschutz 2007. We recommended the Speedy Gonzalez block-stock system. When the stock was shipped to the shooter, he simply placed his barreled action in the stock, torqued the four receiver screws to about fifty inch pounds, and upon testing, reported improved consistency and accuracy.

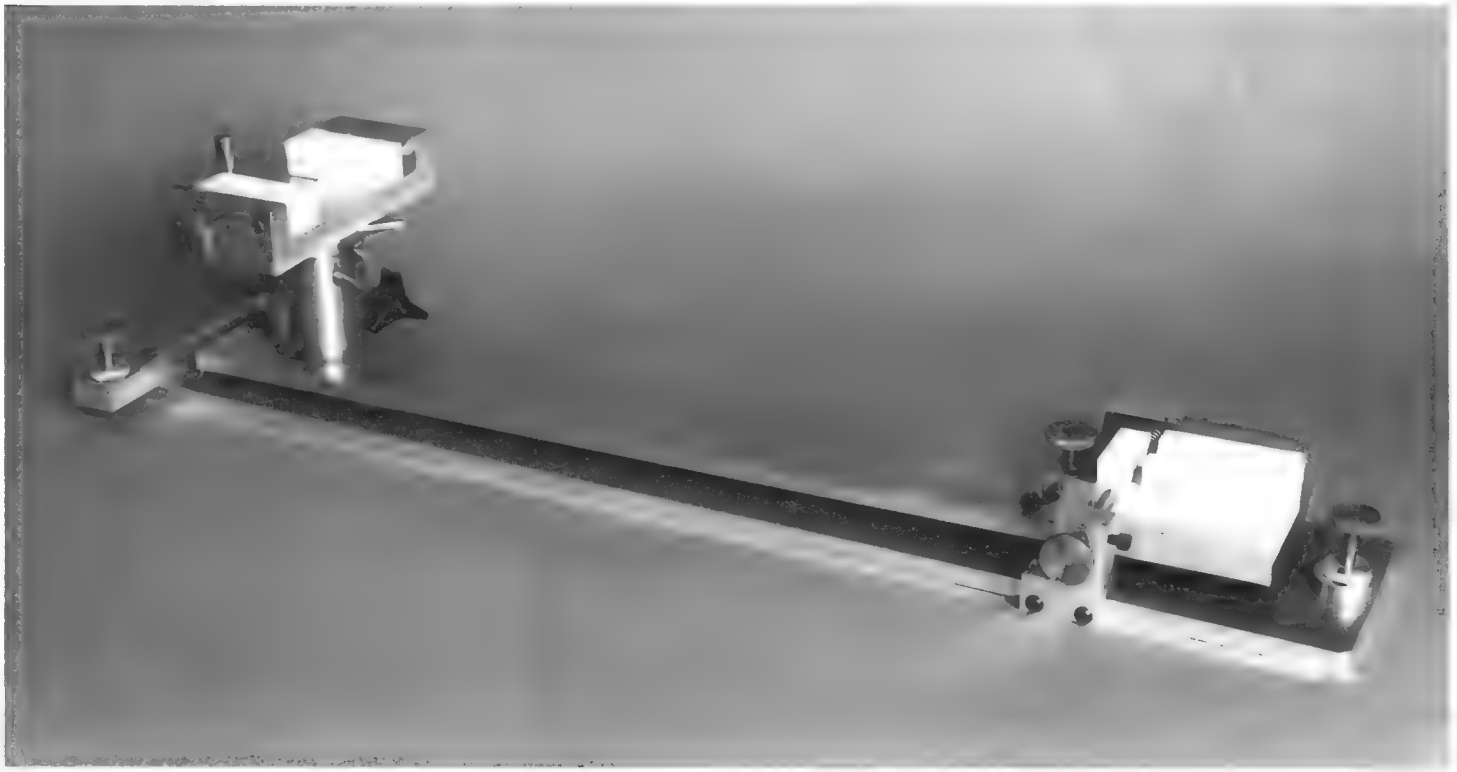
This system will not make a bad rifle good, but it will give you improved accuracy. It will not tell you when to pull the trigger in a switching wind condition, but it will allow you to make condition corrections with more confidence when you know your rifle is as accurate as it can be. It is almost impossible to learn "dope" conditions with a rifle that is not accurate.

The 2007 does not seem to be lot sensitive when set up using this system. All of the testing was done using Lapua Midas L or Lapua Multi Match without it showing much preference for various lot numbers.

If at first blush this rifle seems expensive, as it did to me, look at all those rifles standing in your gun safe that are not competitive. I'm still trying to figure out what you do with a competition rifle that won't compete. I have figured out that they are the most expensive rifles you own- in more ways than one. I have never heard it said that this was a game for the faint of heart or weak of hip, but if there is will we will probably find a way.

The most recent testing was done using the "new" Anschutz factory barrel. This barrel is 500mm long. It has the characteristic Anschutz "knob" at the muzzle end, then has a smaller diameter back to the front of the receiver. It performed well and had the added advantage of a lighter weight.

Aluminum blocks for other models are now available or currently being designed. It seems, at last, we have available a competitive combination for those shooters that demand extreme accuracy in the .22 Rimfire. (SGY Rifles is of course a Precision Shooting advertiser)



22 MATCH BULLETS

BY BEN PEAL

I recently called to place an order for the custom match bullets I have been using in my Short 22 and the Waldog, only to find my supplier backordered. With delivery forecast in three to four weeks. I though it might be interesting to explore something most of us seldom consider... "commercial" bullets for a benchrest rifle. I had a couple of boxes of custom 22's remaining, plus Sierra and Hornady Match 22's which I load for the Grandson's rifles. The commercial manufacturer's, Sierra, Hornady, Speer and Nosler, offer a wide variety of excellent bullets for reloading and fire thousands of rounds in developing, testing and evaluating their products. For more than 40 years, I have used reloads exclusively for deer and varmints with complete satisfaction.

When shooting benchrest rifles, we usually find a custom maker's bullet that gives from the teens to the low twos in our rifle(s) and stick with that brand. If we opt for a commercial bullet, we may try a few groups, then return to using the custom bullet that has been giving us those small clusters. I have used most of the commercial 22 bullets in various 222 Remingtons, 222 Remington Magnums, the 22/250 and 218 Bee. It isn't hard to find one or more that gives excellent performance in varmint rifles. Two of my favorite suppliers, Sierra and Hornady, offer Match 22 bullets as well, but I haven't been able to get them to shoot as well as custom bullets in my light varmint Panda. This is contrary to my experience with a Model 700 Remington 222 which prefers Hornady 52's to the custom made 22's and a Sako Vixen in 222 Magnum that shoots its best with Sierra 53's. As you know, a barrel's performance can sometimes vary from what we think of as the norm. Note in the summary in Table 1 that Berger's 52 MEF, a varmint bullet, gave me smaller groups than his 52 grain match bullet. My 22 PPC was just the opposite! Benchrest rifles are like racehorses... unpredictable.

My first introduction to match bullets was back in the 60's, when I ordered a Remington 40x in 222 Magnum caliber. Remington provided their test targets with the rifle and showed that it would shoot three consecutive five shot groups at 100 yards that would average 3/8". And it would do just that! The bullet I used was the Sierra 53 grain Match H.P.. Any bullet that shoots 1/2 M.O.A. or less in a tuned varmint rifle is certainly a good bullet and both Sierra and Hornady match 22's routinely do this for me. I just can't seem to get'em below 1/4" at a hundred yards with my benchrest rifle.

I decided to fire a series of 5 shot groups at a hundred yards in what I hoped would be a fair comparison of commercial and custom bullets. I wanted to fire 25 round aggregates for this comparison. The rifle I used was my Panda Light Varmint in short 22 caliber, with a Shilen barrel and B&L 36x scope. This barrel shows some wear but still turns in good groups. Over my 3 days of shooting, many groups had 3 or 4 shots in a nice little hole and I considered most of the ones "out" to be reflective of my abilities to manage conditions. You usually know when you give a little push or get caught by a wind shift. And of course, you also know that anytime you plunk your first 3 or 4 shots neatly together, a "little bit of pressure" builds up to sometimes blow the group all to heck and gone.

I have tried to make test results more meaningful by reporting the small group, large group, and the 25 round average for each bullet. Now we all know that 25 rounds is not enough for statistical evaluation, but I feel it is a good indicator of performance for a particular bullet and rifle. Table 1 shows my test results. At this point, I would like to state that I have no particular bias for any one bullet. Like most shooters, I have my preference but I use what works best at the time in a particular barrel.

The best commercial bullet in these tests was the 53 grain Hornady, with a small group of .193, a large group of .323 and a 25 round average of .2674. The best custom bullet in these tests was the 52 grain JRP, with a small group of .089, a large group of .269 and a 25 round average of .1794. The JRP custom bullet, out of Whitehall, New York, is a new bullet for me, one that I recently ordered from an ad in the February issue of *Precision Shooting*. I was very pleased at the initial performance of this bullet, with groups of .089, .177, .117, .185 and .269 for an aggregate of .1794.

Were there any surprises in all of this for me? Yes and no. I expected custom bullets to perform best and they did. I expected commercial bullets to come in second, but they were a close second. Bear in mind that I simply extended load data that had worked well with the custom bullets to their commercial counterparts. Maybe with a bit of experimenting, I can improve on the performance of Sierra and Hornady's Match 22's in my target rifle. Some may say, why bother? I say, why not?

TABLE 1
Commercial and Custom Bullet Comparisons

BULLET	SMALL GROUP	LARGE GROUP	25 RD. AVERAGE
Hornady 53 Match	.193	.323	.2674
Hornady 52 Match	.216	.349	.2703
Sierra 53 Match	.220	.340	.2792
Berger 52 Match	.180	.333	.2482
Berger 52 MEF	.110	.262	.1852
JRP 52 Match	.089	.269	.1794

HI-YO SILVER!

The Lone Ranger Reloads Again

BY HAP ROCKETTO
with the technical assistance of
STEPHEN M. ROCKETTO, MA
Instructor of Mechanics and Natural Philosophy

I am just old enough to have been able to enjoy the last part of radio's 'Golden Age'. As a child I was able to sit by the radio, in a semi-dark room, and listen to the serialized adventure stories of real and imagined heros. *Gang Busters, Tennessee Jed, The Shadow, Suspense,* and *Johnny Dollar* — the man with the action packed expense account, were great favorites. As a kid growing up in Connecticut *Johnny Dollar*, an insurance investigator, was particularly interesting because his office was in Hartford, which is both the state capitol and the 'Insurance Capitol of the World'. Radio had such an impact as a popular medium that a joke of the time defined an intellectual as a person who would not conjure up the image of *The Lone Ranger* at the playing of the finale of Rossini's *William Tell Overture.*

As a child I was an avid fan of 'The Masked Rider of the Plains and his faithful Indian companion, Tonto.' My older brother was, to my chagrin, so dedicated a Hopalong Cassidy fan that our room was decorated with Bar XX Ranch linoleum and a similar waste basket. He even had Hopalong Cassidy pajamas, which he quite often wet at night. But, that is another story It was at the time I just began my love affair with shooting and I was always fascinated by the Lone Ranger's use of silver bullets. All loyal fans of the Lone Ranger know that he started out on his life of crime fighting after his party of Texas Rangers was ambushed by Butch Cavendish and the bandits of his gang. Then known as John Reid, The Lone Ranger was the only survivor. He was nursed back to health by Tonto, a member of the Potatomi tribe, after the Indian found life in his bullet ridden body.

When recovered from the wounds that almost took his life he and Tonto repaired to the silver mine he had worked with his brother, who was killed in the ambush, to mine some silver to fund his new career. This was at the time of Sherman Silver Purchase Act. This federal economic legislation required the United States government to double its purchase of silver. The Lone Ranger could have become a rich man, a metal magnate if you wish, had he not embarked on a more altruistic life of crime fighting.

It was at this time he must have hit upon the idea of using an emblematic silver bullet in his crusade against lawlessness. I am sure it was selected because of its obvious symbolism. The bright and durable metal represented the nature of his quest to seek justice in a dark world. This struck me as a particularly unusual handloading technique but not until recently has the idea of using silver bullets become a bit of an intellectual exercise. After reading many articles in *Precision Shooting* dealing with accurate bullets, barrels, and loads it seemed a small leap to investigate the Lone Ranger's load.

After doing some research I was forced to set up parameters for the project. The first was to establish a time frame for the Lone Ranger's activities. We know that his grand nephew, Britt Reid, followed in the family footsteps in crime fighting as the Green Hornet. The Green Hornet radio series was very popular from the late 1930s through the early 1950s. Like Bishop Ussher, the Anglican bishop of Ireland, who established the date of creation at 4004 B.C. by counting backwards through the generations of Biblical figures. My task was less formidable as I only had to count back two generations. This places the Lone Ranger's earliest adventures as occurring in the decade between 1880 and 1890. This fits perfectly into the hey-day of the era that popular culture labels 'The Wild West'.

The second issue I had to resolve was the caliber of the Lone Ranger's firearms. Although he is often pictured with what looks like a Colt .45 'Peacemaker' I believe that he would actually be carrying a 7½ inch barrel Colt Single Action Frontier Revolver Model 1872, chambered for the .44-40 cartridge. The .44-40 Frontier Colt was the favorite of James B. Gillett, a sergeant in the Frontier Battalion of the Texas Rangers. In the last decade of the 1800s Gillett spent six years as a Ranger, ending his law enforcement career as the Marshall of El Paso, Texas. If a .44-40 was good enough for a

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law man of the stature of Gillett than why not our hero?

His long gun would be, of necessity, the Winchester Model 1873 Repeating Rifle chambered for the same cartridge as his revolver. The eminently practical idea behind this concept was that is desirable, from a logistical standpoint, to have just one cartridge to purchase and/or reload. Considering the Lone Ranger's nomadic life style, and the fact that he gave away one silver bullet each episode as a form of business card, two calibers of cartridge would seem impractical. These firearms also fit nicely into the calculated time frame.

It is reasonable to presume that he did his bullet casting and reloading at his secret silver mine because he most certainly had smelting facilities available there that were up to the task. Perhaps the old buffalo hunters melted and cast bullets over an open fire but not the Lone Ranger. He did not have a wagon to carry his supplies, the heavy silver ingots would have taken up valuable saddlebag space. A camp fire would not provide the necessary temperature to melt the metal, even in the unlikely event that Tonto would volunteer to pump away at the flame with a hand bellows.

Lead melts at 328 degrees Celsius, a temperature that can be readily produced by burning wood in a campfire, as evidenced by the successful bullet molding activities carried out by generations of American frontiersmen. Natural silver needs a temperature of 962 degrees Celsius and this requirement necessitates the use of more sophisticated metal working facilities than a camp fire.

John H. Barlow began producing his soon to be famous line of reloading tools in New Haven, Connecticut in early 1884. Barlow was discharged from the Union Army as a First Sergeant, after serving in Arizona among the Indians. He moved to Connecticut and worked for both Parker Shotguns and Winchester Repeating Arms before setting up is own business under the name 'Ideal' at 187 St. John Street in the 'Elm City'. His line of reloading tools, such as the Ideal No. 3 reloading tool were mainstays with sportsmen across the United States. The firm was later purchased by Marlin Firearms of New Haven which eventually sold the product line to the Lyman Gunsight Corporation in Middletown, Connecticut. Middletown is located about halfway between Hartford's Colt Armory and New Haven's Winchester Repeating Arms factory It also fits very nicely into our story.

For the sake of this argument, and to keep the Connecticut flavor, I am going to have the Lone Ranger purchase an Ideal four cavity bullet mold to feed his Connecticut made pistol and rifle. If we are willing to accept the fact that he probably used a conical bullet his purchase probably was the 1880s equivalent of the modern Lyman projectile #445369.

The bullet produced by this mold gives us a weight, in lead, of 291 grains. This translates into 275.6 grains of silver. At this point I must confess that my ignorance of pistol reloading is nothing short of total. To solve the problem I contacted the Ballistic Technical Service of Sierra Bullets, where fellow *Precision Shooting* columnist Kevin 'Doubting' Thomas oversees his merry little band of ballistic boffins. I am sure that my E-mail request caused a few members of the Technical Service crew to spin their index fingers in small circles next to their heads in symbolic reference to my mental state.

Rich Machholz, who certainly takes Missouri's nickname of the 'Show Me State' seriously, tapped at the keys of his computer and did a little research. Through a back and forth E-mail correspondence he both guided and chided me through the intricacies of handgun reloading while coming up with data that indicates that the Lone Ranger could well have created his legendary silver bullets so that they would be both safe and accurate.

A 275.6 grain bullet, with a charge of 40 grains of FFFg blackpowder, would produce a cartridge similar to the modern load for a .44 Magnum Semi Wad Cutter that uses 30 grains of Pyrodex Select to push out a 240 grain cast bullet. Pyrodex is a modern gun powder that simulates blackpowder without all the muss and fuss. The resultant pressure would be about 9,800 Copper Units of Pressure (CUP). A CUP is an equivalent measurement of pounds per square inch as determined by the amount a copper slug is compressed by the pressure exerted on it by the force of a powder charge's detonation. Essentially the slug is held in place in a vice-like device in a specially built universal receiver. A piston is forced against it, crushing it, when the force of the powder charge is vented against it through a hole in the receiver. 9,800 CUP is well within the safe range for a blackpowder pistol. So it seems that the idea of silver bullets is both practical, although maybe not from an economic stand point, and safe.

Incidentally, the Sierra factory is located between my two favorite places in Missouri. The Lake City Ammunition Plant that produced the ammunition that helped me earn Distinguished is outside of Independence. Westminster College, where I bamboozled the faculty in to thinking that I was worthy of earning a Bachelor's of Arts degree, is in Fulton.

Lead is a softer metal than silver and the wear on the Lone Ranger's firearm's barrels must have been terrible with silver bullets. Lead has a hardness of 4.2 on the Brinell Scale while silver registers at 60.0. Mild steel, common in firearms manufacture in the late 1800s has a hardness of 16. Perhaps this accounts for the fact that the Lone Ranger generally subdued his adversaries by guile or by using his pistol or fists to render the criminal unconscious. It was not that he was a kinder or gentler man, it was just that he was practical one who didn't want to shoot out a good barrel. After all, this was in the days before moly.

As handy with a gun as the Lone Ranger must have been, a thump on the skull caused less barrel wear, saved expensive ammunition, and brought the miscreant to the bar of justice in an unventilated state to stand trial. Subduing a criminal by the judicious use of the gun butt, or *in extremis*, the barrel probably would not risk as much damage to the firearm as tearing up the rifling with tough bullets.

It appears that the Lone Ranger's silver bullet might be a legend of the Old West but it is also a realistic load. It has symbolism, practicality, and a possible third side effect. There is little evidence of werewolves in the southwest. Is it possible that they were scared off by the very presence of the Masked Man, his faithful Indian companion, and a gun belt with the cartridge loops filled with silver bullets?

TWO-STAGE TRIGGERS
A REVIEW

BY BOB GREENLEAF

A two-stage trigger is a mechanism that has two distinctly different weights of pull with the heavier following the lighter. Usually the lighter pull is long and the heavier pull is much shorter or even seemingly motionless. The first rifle to have a two-stage pull was probably a military rifle around the 1870's but exactly which is difficult to determine. It may have been the 1874 Hotchkiss which introduced cocking when lifting the bolt handle. The later, 1879, Lee Navy rifle certainly had a two-stage trigger and introduced the box magazine.

Incidentally, the 1867 Peabody-Martini introduced the sear blocking trigger mechanism which is a single stage device very popular on today's sporting rifles and many target or varmint rifles.

The original two-stage triggers were used on military rifles for safety reasons and to reduce the chances of inadvertent discharges. The sears had three or four millimeters of engagement with the cocking piece. The first pull of the trigger reduced the engagement to roughly half, and the second pull completed the disengagement and the rifle fired. If the finger was removed from the trigger when the heavier pull had been reached, the sear would completely reengage the cocking piece. It is almost impossible to have a military rifle with a two-stage fire when dropped, cocked and the safety off, from any attitude. Some years ago I did some drop tests on an Anschutz match rifle with a two-stage trigger, and it passed in all attitudes from heights much greater than the present ANSI standards. Match rifles are exempt from the standard so the test was done only out of curiosity.

The military two-stage trigger operates on the lever principle. The trigger is pinned on the sear but contacts the bottom of the receiver. Close examination of the top of the trigger reveals it has two humps, and when there is no pressure on the trigger the hump closest to the trigger pivot is in contact with the receiver. Pulling the trigger rearward causes two things to happen simultaneously. The sear moves downwards reducing its engagement with the cocking piece to

Although there are several fine American aftermarket triggers available the most popular is the Jewell, designed and made by Arnold Jewell in San Marcos, Texas. These are single-stage mechanisms that can have a two-stage feature added. Either top or bottom operated safeties are available for the Remington 700 actions. The two-stage pull is achieved by essentially having two springs acting sequentially. Because the trigger and a lever are not in engagement when there is no pressure on the trigger the mechanism is not sensitive to abuse such as vigorous closing of the bolt or even dropping the gun. The two-stage mechanism is popular with shooters doing the National Match Course and some Palma shooters.

The Jewell triggers are available for bench rest rifles either Remington based or using Remington style mounting. Also, of course, for Model 700s, 40x, etc; the Winchester Model 70 and its clone the Dakota 70. There are two versions for the Sako Finnfire P94 (only) and a model dedicated to the Cooper Arms rifles and certain Kimbers. Interestingly, this mechanism has an extension spring between the trigger and the release lever. At this time a completely new mechanism for the ubiquitous Ruger 10/22 is becoming available. It is a single stage affair with the range of pull from 6-8oz. to 4.5 lbs. All the other Jewell triggers can have the two-stage feature for only $15.00 additional. The weight of pull when used as a two-stage trigger is 5oz. first stage and 10oz. final stage; these are minimums and are necessary for "over the course" rifles so there be no "follow downs" or "jar offs". In the photo, the Remington trigger is on the left side, and the Winchester trigger is on the right side.

roughly one-half, and the front hump is no longer contacting the receiver, but the rear hump is now touching. Since the rear hump is further from the pivot than the front one was, the leverage has changed, and it now requires more pressure on the trigger to complete the disengagement of the sear with the cocking piece. With the change in the length of the lever arms less motion of the trigger is necessary to cause movement of the sear. The military two-stage mechanism is a marvel of simplicity, reliability, and function. The second stage weight of pull can be reduced by changing the sear spring. Its only function is to ensure that the sear engages the cocking piece. Regain of full engagement does not depend on the sear spring, but rather on the angles and geometry in the relationship of the cocking piece, sear, and sear pivot.

Two-stage triggers are not only used on striker equipped guns but also on internal hammer guns such as the M-1 rifle, M-16 or AR-15S, FN-49s, SKSs, AK-47s, etc. The basic principle is the same - a lot of engagement and short and long lever arms.

The two-stage triggers intended for match or competition use have no apparent motion in the second or heavier pull stage. A problem with the so-called "two ounce" single stage trigger is the fact that much practice is required to learn to use them reliably. The fault is not due to the mechanism but sensitivity, or lack thereof, of trigger finger skin. With a two-stage trigger the second pull can be a bit heavier minimizing the chances of inadvertent discharge. I believe this is due to Weber's Law: Sensation is proportional to the logarithm of the stimulus. That should explain the whole matter - if it doesn't, forget it. It is not unusual for 2 oz. trigger pulls to vary 0.2 oz. or 10%. Some shooters can detect this difference and they complain about it. A 0.2 oz. variance on a 4 oz. Trigger is only 5% which is livable (Weber's Law!). The variance is due to friction variations, engagement variations, clearances, return spring variations even though they are very slight, etc. A four ounce weight of pull provides a much more positive feel, and the mechanism can have no creep or overtravel in the final stage.

All "2 oz." triggers have an intermediate or middle lever between the trigger and the sear, and the principle goes back many years. Anschutz introduced their first two-stage match triggers in the early 1960's (1404-U8). It has been popular ever since, and it has been adapted by some to center-fire match rifles. A few years ago Anschutz redesigned their trigger mechanisms completely. The original mechanisms had steel housings and were only moderately complicated. The new ones are recognized by having die-cast Zamac (zinc) housings and are very complicated internally. It makes use of extension springs which are rare in firearms. The only gun that comes to mind with an extension spring is the KEL-TEC P-11 9mm pistol which has an extension spring to operate the hammer.

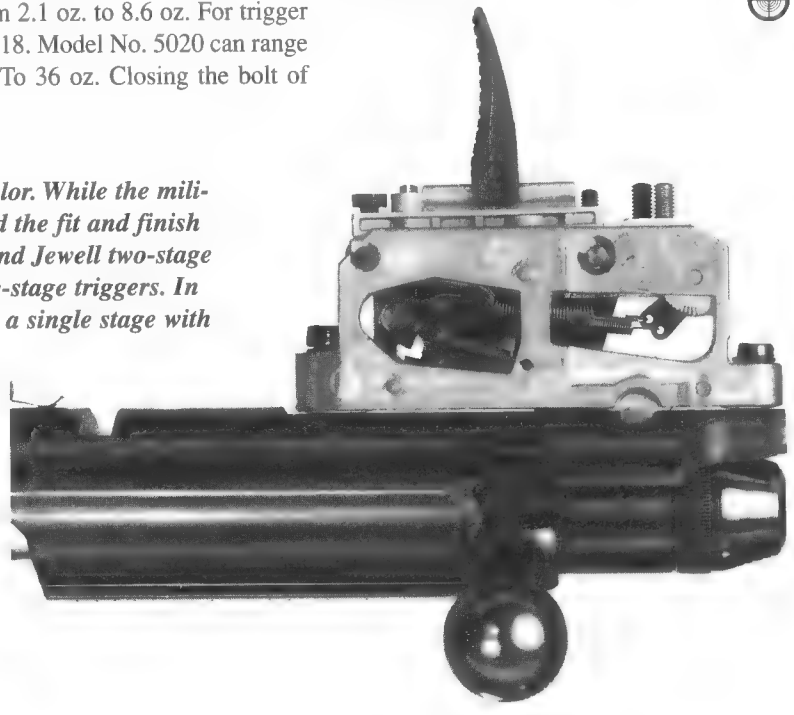
The sear engagement with what Anschutz calls the "catch" is about 0.010". When the creep of the first pull is taken up and the second stage is reached, the engagement is reduced to about 0.001"! Incidentally, the range of the trigger pull weight is from 2.1 oz. to 8.6 oz. For trigger model No. 5018. Model No. 5020 can range from 3.5 oz. To 36 oz. Closing the bolt of rifles with light triggers, of any style or design, should not be done vigorously but gently, or an inadvertent discharge may result. Remember a shot in the sky or ceiling can count as a miss. Also, never use the safety if the gun has one. If you are not going to shoot immediately, open the action and raise the bolt handle all the way up.

One of the main reasons that a two-stage trigger is preferable to a set trigger is reduced lock time and no jarring of the gun by the "kicker" or "knock-off".

It is very important for trigger mechanisms to be kept clean. They must not be lubricated as the oil film acts as a dust and dirt magnet. Do not allow any bore cleaning solvents or chemicals to get into the trigger housing. Some mechanisms require removal from the receiver for a good cleaning. An ultrasonic tank with the proper solution is ideal.

It should be allowed to dry before reinstallation. The Winchester Model 70 and the Savage Model 110 can be cleaned while on the receiver. Use Kleen-Bore "Gunk Out" or brake rotor cleaner; then blow out the remaining dirt and debris with an air hose.

This writer considers it a shame that the two-stage trigger is not used more. The fact that it can prevent accidental firings with possible injuries or death is, alone, a good reason to have it. No one thinks he will drop his rifle, but nationwide it is a daily occurrence. If you try a good two-stage trigger for a while, you will appreciate the additional control it provides and you will stick with it.



The match rifle two-stage trigger is a horse of another color. While the military trigger is simple the match trigger is complicated and the fit and finish of the parts must be of the highest order. The Anschutz and Jewell two-stage triggers are really adaptions of their very light pull single-stage triggers. In fact, the Anschutz two-stage trigger can be adjusted to be a single stage with no first stage or play. The Anschutz Model 5018 and 5020 have no less than seven adjustments and were not intended for the casual tinkerer. The illustration is from an Anschutz owner's manual. Note that #12 and #13/14 are extension springs. The original Anschutz rifles had a wing safety on the rear of the breech bolt that locked the firing pin when on "Safe". On later rifles this safety was discontinued and a safety mounted on the trigger mechanism. While it is unnecessary if the action is open I would not remove it for liability reasons.

Speaking Out On ...
MOLY PRE-CONDITIONING

BY DAVE SCOTT

'Tis better to remain silent and be thought a fool than speak out and remove all doubt' — Willie Shakespeare

Yesterday I answered yet another inquiry about Dri-Slide, a moly-based lubricant I mentioned in an article in the December, 1996 issue of ***Precision Shooting***. As I write this piece, three months have passed since the earlier story appeared, and letters continue to dribble into Granbury, each inquiring where the lubricant can be obtained. Never has one of my gun-related tirades triggered such an outpouring as that incidental mention of Dri-Slide.

Don't get me wrong. I'm not complaining. Far from it. One of the truly enjoyable aspects of contributing to these pages is corresponding with mah fellow shooters. I'm convinced that a sharper, more interesting group of individuals never trod planet Earth. Still we need to resolve this matter so those of you who remain curious but didn't write or call for clarification on Dri-Slide can get on with your otherwise desolate existence.

In said article, entitled "Sold on Moly-Coated Bullets", I reported that prior to passing the very first moly-coated bullet through my relatively new Shilen 6PPC barrel, I had in essence "conditioned" the bore by enthusiastically working in Dri-Slide applied with a patch. Grasping for a rational reason, I theorized that pre-conditioning with this general-purpose lubricant, which contains fine moly in a petroleum distillate carrier, might supply needed moly lubrication for the first bullets. After all, I further speculated, due to the thin moly coating on the projectiles, several shots are possibly required to sufficiently distribute the dark powder down the bore. And any metal fouling laid down before then would undesirably shield the underlying barrel surfaces from moly lubrication and impregnation and thus temporarily compromise the effect. The reason I used Dri-Slide was because at the time it was the only moly-containing product in the house. Although I was in possession of moly-plated Berger bullets, my NECO kit had not arrived.

For a while thereafter I continued to Dri-Slide the bore after each cleaning, figuring this product was as good as any to replenish moly stripped away by cleaning. Then upon sober reflection, it occurred that ***if indeed bore pre-conditioning provides any benefit at all,*** the best way to go about it is simply to apply the very same powdered moly used to coat bullets. Why introduce a foreign substance like petroleum distillate when it likely serves no use?

Consequently, I took a bore mop and snipped off all but about 1/2" of the fuzzy section and then coated the severed wire ends with a drop of epoxy to head off potential chamber or bore damage. Although it might not be an improvement, I fitted a cloth covering over the shortened mop, calling upon my formidable skills with a needle and thread to hold it in place. With the cloth charged with NECO moly powder as needed, the device does a nice job. After use, it's stored in a dust-tight container. Chances are, an unadorned mop will work equally well.

As I see it, the objective is to patch the barrel dry of solvent after cleaning and then burnish the bore with moly, leaving nothing more than a light smear. Of course, if bore rusting is a threat, by all means either apply your trusted rust preventive and then the moly or simply add moly to the preventive. There are many ways to skin Garfield. You'll figure out the best one for your circumstances.

To finally answer the searing question that precipitated the whole issue, Dri-Slide is manufactured by Dri-Slide, Inc. of Fremont, Michigan and is available from Brownells, 200 S. Front St., Montezuma, IA 50171, (515) 623-5401. I've also been advised that another moly lubricant, Smooth-Kote, has great possibilities for pre-conditioning. Information is available by calling 1-800-546-8049.

Incidentally, if I reveal a touch of skepticism over the very practice I've advocated here, it's simply because I've not proved (or tried to prove) that it offers any advantage whatsoever over simply relying on coated bullets and perhaps a lightly oiled barrel to prevent the first shot or three from opening the door to the jacket-fouling process. And in fact, M.L. McPherson weighed in on this very issue in his instructive article in the December, 1995 **PS**. According to M.L., "Even the first moly-treated bullet fired through a clean bore is well lubricated because the bullet is covered with excess moly, which it can donate to the bore. Therefore, as the bullet passes through, the bore is spontaneously coated with moly-disulfide."

Nevertheless, there will be those intrepid souls who openly embrace the pre-conditioning concept despite dissenting opinion. Including me.

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(STILL) MORE ON MOLY

BY WILLIAM B. BAILEY

Most of the articles written about molybdenum (di) sulfide coating of bullets have concentrated on the technical aspects of the process or properties. Given conversation in the pits at the Long Range Championships in Phoenix in early February, it appears that an article on the practical aspects of "moly" coating bullets is in order. The consensus seemed to be that moly coating was the messiest and most miserable process ever to mar the pleasures of rifle shooting (or add to the misery, depending on how you are shooting that day).

This author has had no such experience. With a minimum of planning and equipment, the mess can be confined to a bare minimum. The trick, if there is one, appears to be in not handling the moly or the media any more than necessary. The first item purchased for the process was a small vibratory tumbler (roughly $45) and an extra bowl and lid for it ($10).

The dry untreated corn cob media is kept on one bowl. The steel shot (BB's) and moly is kept in the other. Neither media is ever dumped out of their respective bowls. Here is how the process works:

First the bullets are de-greased and dried. This author started degreasing them with aerosol can brake degreaser advertised to dry without leaving a film. The bullets were dumped onto an old folded towel, sprayed, and rolled back and forth in the towel before being dumped into the dry corncob for three to five minutes of tumbling to fully dry and clean them. Most degreasers are rather nasty compounds (smelly, too,) so this has to be done out of doors. The process worked well.

Since then, it has been has learned that the lubricant on the bullets is soap. Now the bullets are placed on a towel in the sink, and boiling water is poured over them. When cool enough to handle, they are then scooped off the (hot) wet towel onto a dry one. Allow a few minutes of air dry. Now off to the tumbler. This is as effective as the brake degreaser. The "right" number of .30 caliber bullets (155 gn. Sierras) seems to be between 100 and 150.

One note: Degreasing is not considered by this author to be an optional step. A colleague who thought it was, wound up tumbling bullets all afternoon, and still did not get an even coating.

Now the bullets go into the other bowl with the BB's and the moly. Four to six pounds of BB's seems to be about right, with a tablespoon of moly. After the first batch, you may need to add about a teaspoon, as most of the moly will wind up on the BB's. (Be sure to degrease the BB's first. The author did this with the brake degreaser, and allowed them to air dry, rather than tumbling them.)

Don't dump the BB's, moly, and bullets through a sieve. Get a plastic slotted spoon ($3) that will allow the steel shot (BB's) to fall through, and not the bullets. You may have to buy a plain plastic serving spoon or ladle and drill holes or cut slots in it with a small die grinder. Fortunately for the Palma shooter, off the shelf spoons seem to be made for .30 caliber. Scoop the bullets out of the corncob straight into the moly and shot. Place that bowl on the tumbler, and tumble until the bullets are evenly coated, and no copper jacket is visible. This will take between 1 and 2 hours.

When even coating is completed, there will be random accumulations of moly on the bullets, giving them a mottled appearance. Use the slotted spoon to separate them from the BB's and moly powder, and return them to the dry corncob. Now tumble them for a few seconds at a time, say 10 sec., checking to verify that the random accumulations are being removed, and that you have not gone too long, and removed the moly. You could get bullets that are not the desired deep silver-blue/black, but are blue/black with the even copper color showing through as an undertone. Rather pretty. (This is acceptable, but not desirable. It can happen quickly with brand new corncob media.)

During this operation, the author doesn't bother to put the lid on the tumbler. This is the only point where there seems to be a tendency to get a little airborne dust. If you are concerned about it you could put the lid on, or wear a mask. Or both.

Since the same bowl and media are used to pre-clean the bullets after degreasing, you will notice a little blue/black tinge to the bullets as the corncob picks up moly from removing the excess after the "impact plating". This is not a problem, and probably indicates that the bullets were well cleaned and that the moly will "stick".

One additional irritant: Noise. The BB's and the bullets make a racket. Do this out in the garage. A plastic 5 gallon bucket placed upside down over the tumbler reduces the noise level considerably. Setting the tumbler on a piece of carpet, or placing it in or under a Styrofoam insulated box would help further. This author hasn't gone to that length. (Most high power shooters are hard of hearing anyhow. What?)

Some people coat the bullets with carnuba wax. The author is of the opinion that this is unnecessary. Rifle competitors do not carry their rounds in their pockets. Other than the little moly that comes off on your fingers while assembling cartridges, there is no mess. When seating bullets, you may wish to wear latex or cotton gloves.

After bullet seating, the ogive is given a polishing with a clean, dry rag. This insures that the last of the random accumulations

Continued on next page

Still More on Moly

Continued

are removed, that the ogive is smooth, and your fingers stay clean while loading on the line. This does not remove the coating, only the random, loose accumulation. Longer tumbling in the corncob after the moly treatment would probably accomplish the same thing, although some dust would remain, and there is the danger of tumbling them too long.

Carnuba wax has it's own set of problems such as being temperature sensitive. It clumps up on the bullets if the ambient temperature is too low. In that condition, it builds up in the seating die, and your bullets get seated progressively deeper. Lastly, it just creates one more burnt residue to remove from your bore. Sounds like a bad habit to get into.

The last practical item is to expect your zero to change. Not just elevation, about which much has been written, but windage as well. (Author cannot resist technical discussion.) The reason for this is called "precession". The following explains the effect, but not the process. The aerodynamics of a spinning bullet's lateral motion are not within this author's competency to explain.

Use the following two dimensional thought experiment: We can all agree that if we had the theoretically popular frictionless surface, we could place a spin on a balanced cylinder, apply motion to it in a direction (vector) coincident to the cylinder's axis, and it would move in a straight line along that axis indefinitely.

Now, introduce the slightest friction between the surface and the cylinder. Two things will happen. First, the cylinder's forward motion will slow. Second, the direction of motion will deviate from the straight line through the cylinder's axis at its initial position. That deviation will be in the direction of rotation. If the cylinder is rotating clock-wise, and it is moving away from the observer, the deviation from straight will be to the right.

In this example, as in the flight of bullet, the forward motion will slow at greater rate than the rotational velocity. The net effect in this example will be greater right-ward deviation as the cylinder slows. (You have probably seen this dozens of times playing pool when spin, or "English" is put on the queue ball. It's curve increases as it slows. This may explain why some Long Range and Palma shooters complain of a different windage zero at 1000 yards than at 600, 800 or 900.)

Articles and advertisements have made much of the reduced deformation of the bullet by contact with the lands if moly is introduced into the equation. From the reduced to eliminated copper fouling apparent when cleaning, this appears to be the case. This lessened deformation has to change (reduce?) the rotational friction of the spinning bullet in the surrounding air. This has to change the amount of "precession" or drift. Complex things are happening at the boundary layer of air at the side surfaces of a super-sonic bullet with a rotational speed in a six figure RPM. (Do the arithmetic: Bullet at 2800 feet per second, one-in-twelve twist or one revolution per foot. 2800 FPS times 60 sec. per min. divided by one revolution per foot: 168,000 RPM.) Quantifying and explaining this effect would make an entertaining Doctoral thesis in aerodynamic engineering or physics.

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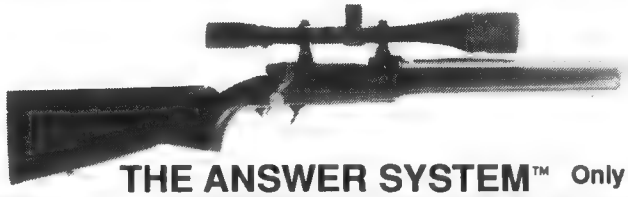

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Bill Nienow and two young gentlemen (on loan from County Clare) lift a top onto a pedestal, completing one of our ten benches.

Building Good Concrete Benches (and Shooting Stools)

BY DICK WRIGHT

The role of a benchrest match director is not an easy one. If you have ever offered your services to the local club to run some benchrest matches, you will find out.... real quick. Most everybody has an idear on how you can do your job better. They don't volunteer their services.... just their advice.

One of the constant (and one of the justified) complaints we had on the score matches we ran in Harrison was the shaky wood benches we used the first few years we had the matches. We had inherited them... they came with the range. After we decided that enough people were interested in shooting and that we would probably be having matches for several years, one of our first projects was to try and put together enough money to build ten cement benches.

The range had ten firing points when we started having matches and we had found that ten was enough for our matches. It would have been very difficult to have many more than ten benches. We would have had to move either a very large berm on the South side of our range or put the benches too close together. Neither option was attractive enough to spend much time soul–searching. Ten benches it would be.

It took a couple of years before we had enough money from match proceeds to start the project. I had permission from the club to go ahead and make the benches, but they didn't offer any money.

During the time we were saving money, we had a good chance to check out the benches at the various benchrest ranges where we competed. As we shot off many different benches (it seems each range has a slightly different design) we soon got a little smarter re: bench design. We decided all cement benches were not created equal.... some were definitely more user friendly than others.

We found some benches were too high. We didn't find any that were too low. We found some that were packed too closely together..... none that were too far apart. We shoot on some ranges where every bench top slopes down a different way. One tilts back, the next tilts to the side. If you are fussy about how your rest sits on the bench, this makes you do a lot of adjusting of your front rest every time you shoot off a different bench.

By the time we had enough money to start our project, we had a pretty good idea what the benches should be like. See the drawing. This is basically the design of the benches at the Holton Gun & Bow Club of Holton, Michigan. Larry Gage and Jim Hutchison counselled me to make the benches 4" longer, front–to–back, than the ones at Holton. Since we have worried about our front rest dropping off the front of Holton's benches a few times, this seemed like good advise. We added four inches to the front of Holton's bench design. Now, after two seasons shooting on these benches, I can't think of anything to change.... they seem just about right.

The first thing we did was make forms from 2 X 4's for the bench tops. We were lucky to have a large flat area of concrete that was unused. We used it to pour the bench tops. We simply laid heavy bisqueen (Spell?????) on top of same, put the forms on the bisqueen, and poured the cement. The tops are reinforced with steel rods running both front–to–back and side–ways. One can also use wire mesh for re–enforcement. This makes for tops that are about three and one–half inches thick. This seems quite sufficient.... the benches are very sturdy and very heavy. They seem to be part of the ground.... just what you want.

We let the cement tops dry for a good month before we had the time to finish the project. We used the time to organize the rest of the materials we would need. Not surprisingly, the hardest thing to get was help from the club members.

What we did to get some help may interest people who have a similar project and who live in a small town. At that time our club president was a detective on the local sheriff's department. He said I could have some trusties come help me if I didn't mind being responsible for them. He said they had done this for other projects and it had worked well for everybody concerned.

The way the program works is this... They will take "short timers"..... young guys (for my purposes, preferably young guys with muscles) with just a couple of weeks left in their sentence. They make sure the kids understand that if they should give me any trouble or decide to walk away, they will be back in the slammer for additional time as soon as they are caught. Since, by this time, the young fellers have had quite enough of the county's hospitality, they are very careful to be helpful and not to wander off.

Let me make this perfectly clear.... we used prisoners from the local jail.

The police obviously don't send any serial killers out to work on club projects. Most of the young guys that helped me were out of

Continued on next page

Building Good Concrete Benches

Continued

work and behind on alimony payments. Being young and hyper, they would much rather work outside on a nice day than sit around inside the local Bastille.

All I did was pick them up at the jail in the morning, sign for them, and buy them MacDonalds Super Size meals for lunch. Actually, the police said they would feed them at noon if I brought them back to the jail. I let the kids vote on whether they got jail house food or Mac's for lunch. Sure made for a lot of enthusiastic help. In the evening, it was back to the county calaboose for my help.

Whilst the writer isn't absolutely sure that Precision Shooting is the proper place for the above, I am sure that most clubs have a problem getting volunteer help. I doubt if this would work well in Detroit. However, in a small Northwoods town of a few hundred souls, it works beautifully.

With my muscle all lined up, all I needed was some skilled help to build the benches. I knew that Bill Neinow from the Holton club had added ten benches to their range in 1993 when they were getting ready for the NBRSA Eastern Regionals. Bill runs a small contracting business and said that he would set aside a couple of days to build our benches. We settled on a price and were "Go" for the big day.

Although our club came with wooden benches, we had a large roof and a cement slab. I can't imagine trying to put these good cement benches on the ground. Put your slab in first.... the job will be permanent and done after you do it the first time.

Actual construction of the benches is no big deal for somebody that understands cement work. Notice that the drawing shows that the top is sitting on a pedestal that is 3–1/2 cement blocks high. All the good benches we shot on over the years use three and a half blocks for a base. The thickness of the top is the thickness of a 2 X 4 (the 4" part, which, again, everybody knows is 3–1/2".) The total height is about 32–1/2". This works very well for benchrest shooting.

If you use "corner blocks" the pedestals look neater. The corner blocks don't help the function, but why not try to make it look as good as possible.

You can use a piece of broken cement block as a "sanding block" to smooth off the corners and edges of the top. Works great.

See the drawing for the stool. These are just like the one's at both Holton's and Kelbly's ranges. They are made from 2 X 8's and 2 X 10's. Note the numbers are different (again) because 2 X 8's don't measure 2" X 8". The 17–1/2" high seems to be a good height... works well for most shooters, as does the 20" length. The height doesn't have to be the same on all your stools. They can be higher or lower to suit shorter or taller shooters.

Bill Nienow brought along an electric drill motor and some threaded "screw nails". You can't believe how fast somebody skilled in this sort of thing can make these little stools. The cutout shown on the stool legs in the drawing is optional. Holton has their's cut out.... we don't.... both work well.

I took a big marking pen and wrote "Stolen from the Harrison Sportsmans' Club" on the tops of two of the stools. These two we left out on the range, by the benches, for use by casual drop–in shooters. The other ten were securely locked up in the range house for use in matches. We made the two extra so we would have ten even if somebody stole the two we left out. (Note: now, a year and a half later, we still have all 12 stools. None stolen yet.)

We let the completed benches dry for a week and a half till we had our next score match. They worked exactly like cement benches should. They are extremely heavy and solid shooting platforms. That's all we ask.

I would advise anybody who wants to make their own cement shooting bench to think a bit before they change the dimensions shown here. These benches are a distillation of the best points of all the benches we shot on over a three year period. They really seem to fit shooters of all sizes very well.

About the only question I have been asked repeatedly is whether we put mortar between the top cement block and the bench top.... "Yes we did and you should." It makes everything more solid.

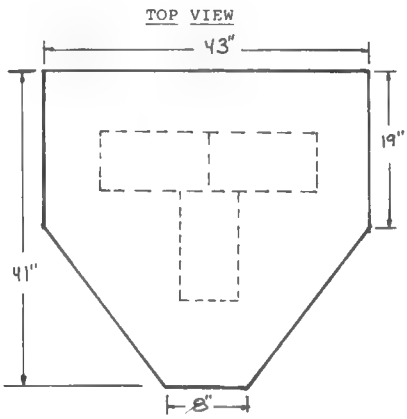
About the only other advice I can give is to spend plenty of time laying out your range if you are going to use it for matches. If the tops of all the benches are literally (as close as possible) on the same plane, it's much easier to set equipment up on the bench. I like the range laid out so you can shoot at the 100 yd. target and shoot right thru same and hit the 200 yd. bull. This makes setting wind flags more fun. (At least, less of a pain in the rear.)

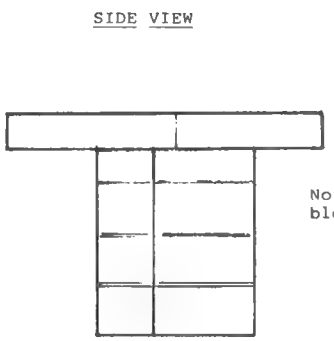
The above is an ideal and should be strived for. However, it works much better in flat country. I can't really imagine doing so on some of the ranges we shoot on in Pennsylvania where the range is built into a mountain.

This bench design and the above construction pointers are just as good as we know how to make them. If you use this design for your own benches and are careful how you make them, you should have very good benches that last a very long time.

Bill Nienow tests his handywork. The just-completed bench held him and is still working well.

Now nearly two years old, our benches have proven to be very good and capable of holding a good deal of weight. Glorya passing out booty to Dana Raven.





"Corner" blocks with square ends shown. Use of these is suggested but not mandatory.

This design ends up aproximately 32-1/2" high.

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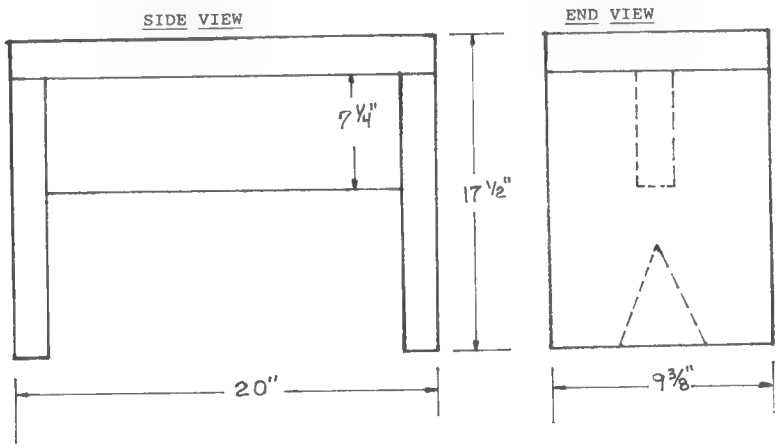

Notes: Make from 2 X 10's and 2 X 8's.

Cut-out shown on end view is optional.

Sanding all sharp edges will save slivers in sensitive body areas.

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Name That Dog

BY DICK WRIGHT

I was both surprised and delighted at the response to my input column in the April issue of Precision Shooting. I must have received around two hundred suggestions for names for the .22SBR (Short BR) cartridge that I have shot for the last few years. Most of the suggestions indicated that some real thought had been put into the matter.

Before I list the best entries, I need to clarify a couple of issues. First, I did not design this cartridge nor have I ever tried to take credit for same. The first time I read about it, was in an article in the NBRSA News by Jerry Hensler of San Antonio, Texas relating his experiences with the little .22. To the best of my knowledge, this round came out of Texas. Unfortunately.... that's all my knowledge on the matter. Because of this, I did not consider any names that directly or indirectly gave me credit for what I didn't do. There will be no ".22 Wright Dog".

Secondly, I had to eliminate a lot of real good suggestions simply because they were too long. I am a benchrest shooter and I shoot the little cartridge in competition. A form that must be filled out before you shoot in a match gives you about this much room _____ (honest) to designate the cartridge you are shooting.

Anyone out there who still wonders why no one shoots the .219 Donaldson Wasp anymore.... take another look at the amount of room you get to put that name in the form. I started this thing as a bit of a lark but took it seriously as I found out how much response I was getting. When the readers got as involved as they did, far be it from me....

This following is a totally subjective decision on my part and should not reflect negatively on the magazine, etc....

Here are my top ten (O.K. so I can't count.) picks with the name of the contributor and any comments I might have. The .22 BRat is my top choice and my pick as a name for this round.

Suggested name	Contributor	Comments
1. .22 BRat	Jim Stekl	Jim, formerly of Remington and Mike Walker's successor was my first caller. He had the winner.
2. Baby Dog	Dr. J. R. Hulme	I really like this name. All of the names listed here were good enough to make it a hard call.
3. .22 Runt	Clint Starkey, et. al	Several folks suggested this name. Clint, of Starkey Bullets was first.
4. .22 Dwarf	Robert Board. et. al	Again several folks wanted Dwarf. Robert was the first.
5. .22 Puppy	Glorya Wright	Do I look stupid enough NOT to make this part of the top ten? Look at the contributor's name once more.
6. .22 Ninja	Nikos Katsikopoulos	A ninja is a tough little guy.
7. .22 GDR	Mark Stouse	From the BlackStar guy. Stands for "Glorya & Dick's Revenge".
8. .22 Half Dog	John Ernst	Good name.
9. .22 Mutt	The writer	A mean little dog.
10. .22 PMS	" "	For Attitude!
11. .220 Twoski	Dwight Scott	Dwight didn't call me or write me with this name. This is what I found engraved on the last barrel I got from him.
12. .22 SLF	David H. Daniels	Stands for "Short Little Fellow".

I have another list of names I really liked but which were not included in the top ten for one reason or another. For instance, I got several really good suggestions from fellow P.S. columnist, Dave Scott. (Of "can't shoot the Beast straight" fame.) Dave, as writers are wont to do, contributed names that were all too wordy to fit on a registration card at a match. Too bad. Here is my honorable mention list.

Suggested name	Contributor	Comments
1. .22 Mothball Express	Dave Scott	Great name, too long.... What can I say? The guy is a writer.
2. .22 Bughole Express	" "	See above.
3. .22 Ezy Wrighter	" "	Neat play on words. Too long and the "Wright" part is a "No, No!"
4. .22 Wright Mite		" " See above.
5. .22 Wynn Wright	Doug Fryer	Good name. Means I'm supposed to win sumpin. Includes the "Wright" word.
6. .22 Wright's Revenge	Phil Sauer	See above.
7. Boss .22	Duane Andrews	Good one! Duane drives Fords.
8. Catch .22	The writer	No comment
9. .22 Raptor	" "	" "
10. .22 Fat Brat	Bill Pendleton	Good name from the Data-Max target guy.

The above were the best of the many suggestions I received. Most all the names that were contributed indicated that a good deal of thought had gone into the suggestion. A very few were just dumb. A couple were pretentiously intellectual.... the thought of shooting a ".22 Socrate's Muse" in benchrest competition gives me gas.

Part of my criteria was to choose a name that would look appropriate on a factory ammo box. I really can see a Remington or Winchester box labeled ".22 BRat". I doubt if it would ever happen but the little round has a lot going for it. I shoot it at a very comfortable 3400 fps with "warm" loads. Hot loading will take you to 3600 fps and the danger zone. The round is amazingly accurate and it certainly is a cute little sucker. Probably it's biggest negative.... it ain't macho. That's the part I like best. The amount of participation in this little contest surprised me and the quality of the answers speaks highly of the readership. I happen to know the editor does not intend for P.S. to be the journal of the "Guns and Blasting" magazine fraternity nor for those who wear T-shirts that say "Kill em all and let God sort them out". Seems the plan is working. Thanks to all who participated,

Dick Wright Staff Columnist

P.S. A note to Jim Stekl, our winner. The Whitetail tools part of your prize will be forwarded shortly, as soon as I get your address. Since Brennan wrote the part about the dinner date with the gorgeous movie starlet, you will have to see him about that part of your prize.

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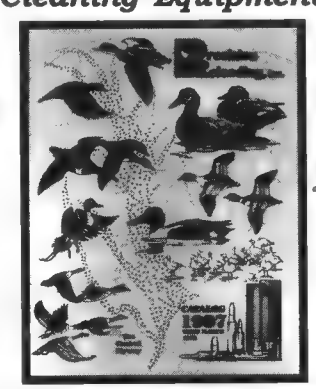

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Action Cycling & Bullet Run-out

BY
RONALD YERIAN &
JEFF DEVORE

When you are testing the accuracy of that "perfect" load for your hunting rifle, do you carefully load the cartridges singly into the chamber instead of loading up the magazine and cycling the rounds through? Do you test the accuracy of your Camp Perry loads by loading them singly into your M1A or your AR-15? Sure you do! Oh, you might run a few rounds through the mechanism to make certain that everything works, but serious accuracy testing is done loading one cartridge at a time.

After all, everyone does it this way. I have seen the fact that the cartridges were loading singly reported in rifle accuracy tests. Some of you may own a "Score High Bench Rest Follower" that is made expressedly to allow a cartridge to be loaded singly, preventing scratched cases and battered bullet noses, thus promoting "utmost accuracy". The implication is, I guess, that the "true potential" of a rifle and ammunition cannot be realized if the ammunition is been beaten up in the magazine. No wonder single shot rifles are making a comeback.

Does anything serious happen to your cartridges when they are cycled rapidly through your firearm's action? This question came up when a friend - Jeff DeVore - and I were sorting through my son's Camp Perry equipment and came upon a M1A magazine marked with a big red "X". My son insisted that particular magazine always produced a flyer with five-ring potential on the last round out! I took his word for it, as the last thing a Highpower Shooter needs is anything breaking his concentration. I mean, if he was expecting a flyer, I'm reasonably certain that he would have gotten one. Jeff, who was interested enough in the subject to help me with the measurements for this article, clearly was skeptical.

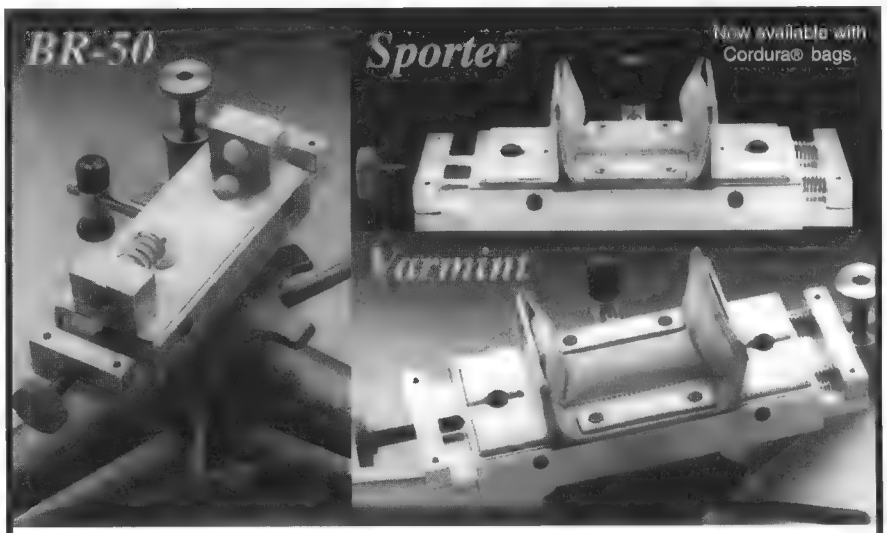
We finally decided, over a glass of what my mother used to call "liquid courage", that it was possible for different magazines to affect the rifle differently, by shifting vibrations, putting pressure on the bolt, or something dark and mysterious and, we surmised, perhaps the cartridge itself could be physically damaged enough during feeding to affect the bullet's impact. The former could only be decided by actual shooting, of course, but the latter should be measurable by checking bullet run-out and case neck run-out before and after cycling.

We waited a couple of months to make the measurements, and in that time lost access to the M1A that started the whole thing, but finally we gathered up our test materials and started the onerous task of checking neck run-out and bullet run-out using a RCBS Case Master. We decided at that time to check cartridges before and after being cycled through three firearms that might show up in either the hunting fields or "on the line" in a Highpower Match - a post-64 Model 70 Winchester in .308W, a FN Mauser in .30-06, and a M1 Garand, also in .30-06.

For cartridges, we used factory Federal Gold Medal .30-06 with 168 gr. Sierra Match Kings; factory Federal .308W with 168 gr. Sierra Match Kings; handloads using LC 89 brass in .30-06 with 168 gr Sierra Match Kings; and handloads using LC 90 brass in .308W, also with 168 gr Sierra Match Kings.

We made two ten-round lots of each of the above, numbered them with a marker, and, with one of us spinning and the other one reading, measured them all.

The initial measurements were a little



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surprising. Case neck run-out on the Gold Medal .308W was never more than .002, but bullet run-out was from .003 to .006, with the .006 being higher than I would have predicted. The Federal Gold Medal .30-06 had case neck run-outs of up to .004, but again the bullet run-out did not exceed .006. My handloads didn't fare too badly by comparison - the LC 90 .308W loads had case neck run-out up to .004, but surprisingly bullet run-out topped at .006; the LC 89 .30-06 handloads exhibited only .003 neck run-out, and again up to .006 bullet run-out. These figures might seem a bit high to you if you are a benchrest shooter, but all of this ammunition is capable of staying in the X-ring in both Military Match Rifles and in bolt Match Rifles. The above figures represent the maximum run-out measured, and in most ten round lots measured only one or two cartridges reached the maximum.

We then fed all the .308W cartridges, factory and handloads, singly through the Model 70, being extra careful not to injure any, and remeasured them, again by number and lot. About halfway through, things got boring. Nothing was happening. We could measure no change in either measurement after chambering them. We then ran the cartridges through the magazine. We cranked them through with the speed and force that would be used in rapid fire, and could measure no change in either case neck run-out or bullet run-out.

Well, what the heck, we thought, this is with a modern, short, heavily constructed case and a push-feed rifle, just wait until we go to the Mauser with its controlled-feed and its long, old-fashioned .30-06 case. So . . . Same process as above - loaded singly, no change. Again we cranked them through the magazine, and again we measured them, and again we found no change!

Not quite sure of what we were proving, we proceeded to repeat the procedure with the M1 Garand. Surely this old war horse would bend some cases! Again, no measurable change, even after being loaded into those En-bloc clips and being cycled through.

By this time we were tired of spinning cases, tired of cycling actions, and had nothing to show for our efforts except a growing admiration for repeating rifles. The last test involved loading M1 Garand clips with the fourth and eighth rounds being numbered and measured. I only loaded five clips this way, for a total of ten rounds to be measured, as I was beginning to suspect that nothing was going to happen. It didn't. I would fire three rounds, extract round four, fire the next three, and extract round eight. I kept the five "fourth" rounds separate from the five "eighth" rounds, and measured them. No changes in either group.

What does all this mean? To me, it means that today's cartridges are perhaps sturdier than I thought, and in a properly functioning repeating rifle suffer no dimensional change when cycled through the action. We have all seen twisted magazine lips, improperly ground feed rails, and bent clips, and the resultants jams, but these are malfunctions caused by faulty equipment and cannot be used as examples of what happens normally.

Recoil forces certainly can affect the cartridges in a magazine. Most of us have seen soft point bullets flattened by the front of the magazine during recoil. A little shoulder in the magazine well prevents this in some rifles. I'm probably not being realistic, but a return to rotary magazines such as those in the old Savage 99 and the Mannlicher-Schoenauer is a possibility given today's technology. Tubular magazines are another matter. I once had a Model 71 Winchester in .348 that required a heavy crimp to prevent the cartridges in the tube magazine from having the bullets pounded deeper into the cases. The culprit in the Model 71 was, of course, the magazine spring slamming the cartridges against each other during recoil recovery. I have read reports that cartridges left in the magazines of heavy-recoiling rifles such as .458's will sometimes be driven into the case after a number of rounds have been fired, hammered back in by the front of the magazine. Conversely, I have seen heavy bullets in double rifles creep out of the cases due to being in the off barrel for a number of shots (the bullet tends to stay put while the rifle recoils away from it).

(Authors Note: We only tested factory ammunition or, in the case of my .308W and .30-06 reloads, cartridges that were loaded for Service Rifle shooting and which had sufficient neck tension to prevent bullet movement in the case neck during action cycling. We were testing for case and bullet deformation, not handloading technique.)

So, in the normal course of things, I don't think that I will blame my next missed woodchuck on the fact that the cartridge had been in the magazine for the last two or three shots, or that I fed it from the magazine.

(ADDENDUM)

In the interest of being modern and up-to-date, Jeff and I repeated the above test with the current Highpower Rifle of choice - the Colt AR-15. We measured one box - two ten round lots - of factory Federal Match .223 cartridges and found case neck run-out to .005 and bullet run-out to .007. We cycled them from the magazine through the action and found no measurable change in bullet run-out (we gave up on case neck run-out). After carefully putting our gear away and retreating to the den for another glass of liquid courage, we agreed to stop this nonsense until somebody else can show us a report, either old or new, indicating cartridge deformation due to action cycling in a modern sporting weapon.

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.22 CONVERSION KITS

NEW LIFE FOR SERVICE RIFLE SHOOTERS

Colt H Bar with .22 conversion kit magazine in place and replacement bolt above rifle.

BY TOM DETERS

Most of us harbor some rather fond memories of our first .22 rifle. Why? Because there is something in the inherent nature of .22s that's just plain fun! Maybe they take us back to the less complicated, carefree times of childhood. But then boys become men (mostly anyway) and become wooed by the likes of service rifles. Quickly, the focus becomes the equipment, the loads, competition and scores. Sometimes the fun part ends up farther down the list.

On my way back from Camp Perry, having just completed my rookie year after being lucky enough to make California State Service Rifle Team, I did a lot of thinking. I made the usual first-time-at-Perry mistakes and learned how the light changes affected my zeroes and I missed a few wind changes. As I planned for better performances in the coming year, I knew that the key to shooting at the next level was MORE PRACTICE! I needed to shoot more often and focus on the fundamentals - particularly trigger control. That observation didn't require rocket science.

But, like most things, easier said than done. While I'm fortunate enough to have a career, not just a job, along with a beautiful wife and daughter, finding the time for that additional practice in is tough. As if I'd had to tell you that.

One logical solution, after listening to a lot of the great shooters out here in southern California, was to shoot smallbore. Many great highpower shooters got their competitive start with position smallbore shooting and most give it credit as the foundation of their success. Smallbore is unforgiving and forces you to focus on technique - without worrying about the time commitment of reloading, high ammo costs etc.. While this was an option, I wasn't keen on transitioning from one rifle and style to the next.

One solution that really interested me was to try out one of those .22 conversion kits that I've seen in ads. This was a viable option for me because I've switched over to a (now let me get this politically correct) a "Colt HBAR Match Target." Incidentally, last year I went so far as to try to make a M1A - 10/22 hybrid for training purposes. Man you talk about ugly, try putting a Ruger 10/22 receiver with a target barrel in an M1A stock! Anyway my switch over to the HBAR made the matter moot.

The problem was that I didn't know anyone who had tried a .22 conversion kit. How did they shoot? Determined to find out, I invested $139.95 plus shipping and handling to find out. I ordered through a mail-order house the kit made by Jonathan Arthur Ciener Inc. 8700 Commerce St. Cape Canaveral, FL 32920 (407) 868-2200. Ciener also makes .22 conversion kits for the .45 pistol and makes suppressers for the military. The goal was to shoot my same rifle lots more for lots less, with reliable functioning and respectable accuracy - a one inch group at 50 yards was what I was hoping for. That's really all I figured I needed to get instructive feedback on my offhand, rapid-fire and even my slow prone shooting. Here's what I experienced.

DESCRIPTION AND FUNCTIONING - I am shooting an Albert Turner built AR15 style upper receiver with a Krieger 1 in 7.7 stainless, Turner float tube, .040 front post and a .040 rear aperture. This all sits on a Colt HBAR Match Target lower receiver. The rifle shoots lights out. Period. At 100 yards it will consistently shoot dime sized 10 shot groups if I do my part. I mention this so that you have an idea for an accuracy comparison later on.

I called Albert Turner and asked him if he had any experience with the conversion kits. He said they generally shoot "decent" - decent being a 2 inch group at 100 yards with no wind, the right ammo and good shooter. The folks a Ciener where a bunch more optimistic and said that they believed that the kit would shoot as good as my centerfire ammo out to 100 yards.

When my kit arrived, it was contained in a durable flat hard plastic carrying case that fits neatly in my shooting stool. The central element to the kit is a bolt replacement for the standard AR15 style bolt and is really a bolt within a bolt. The replacement bolt has what looks like a .223 case stuck on the end which fits in the chamber. The .22 cartridge fits inside of that, providing bore alignment. It also provides a healthy bit of bullet jump, about an inch, before contacting barrel lands. Additionally, the kit comes with a 10 round magazine which is a tad shorter than my standard AR15 .223 20 round

box mag. At least for me, the size difference is negligible in how it effects my offhand hold position.

With the conversion kit in the rifle, I headed off the range for testing with one box of each of the following brands of .22 ammo: RWS R-50, Eley Tenex, Federal Gold Medal Target, Eley Club, Eley Standard, Eley International, Eley Standard and some Remington High Velocity. I took my prone slow fire position and began carefully shooting 10 shot groups at 50 yards (no wind).

The differences in groups size where both dramatic and reproducible. The group sizes ranged from a horrendous 4 inches (plus 2 uncalled flyers) with the Federal Gold Medal Target to approximately 3/4 inch with the Eley Club. There was a tie for second best groups with RWS R-50 and Eley Tenex at about 1 1/4 inches, but in my rifle, the Eley Club was the clear winner. All other brands grouped around the two inch range with the exception of the high velocity stuff which was closer to three inches.

It should be noted that Ciener recommends the use of high velocity ammo to insure adequate blow back pressure and proper feed function. Even though I used standard velocity ammo, I experienced only two feeding problems over three sessions (about 250 rounds), all of which occurred during the first 50 rounds (I think the slide and bolt were a bit stiff at first). I've not had a malfunction since. In my opinion, and for practice purposes, a occasional feed problem which was cleared in seconds is worth the extra accuracy with the standard velocity ammo.

A word on cleaning. Ciener makes it clear in their product literature, and so do I, that if you want to fire .223 cartridges anytime after using the conversion kit - be it the same session or days later - the barrel and particularly the chamber must be cleaned first. Lead fouling - and there will be some lead fouling - in the case head and neck area from the conversion kit could affect headspace, functioning or create some other hazard. I have, on the other hand, done some practice with the real stuff and them put in the conversion kit with no problem.

Any way you slice it, I was very satisfied with the experience in general and the results in specific. No I wouldn't trade it for an Anshutz in a smallbore match, but it sure works for me. The following are a list of potential benefits for you to consider:

SAVES MONEY!: I can shoot the .22 conversion kit all day for a small fraction of what it costs to bust caps with the real stuff. As I stated above, I settled on Eley Club which I purchased from Accuracy International for $35 per 500 (I'm ordering a case which will bring down the price now that I know it's the right stuff for my rifle). With shipping and handling that comes to about 8 cents a round. Want some more good news? The more you shoot, the more you save. How's that for rationalization!

You'll also save big time when it comes to barrel life. How many rounds would it take of .22 to shoot out my Kreiger? 30,000? 60,000? A lot!

SAVES TIME: We've all been there. It's Saturday night, the baby finally went down, the wife's asleep and you're in the garage scrambling to get enough ammo loaded to get in your weekly (sometimes monthly!) practice session. Not with the Conversion kit. That translates to less frowns and more time to spend with family, which to be totally honest with you, I'm hoping to parlay into an extra week at Perry next year. I've found that when I do reload now I find it a lot more enjoyable without the time crunch.

YOU'LL GET TO SHOOT MORE: Think of how many more range possibilities you have with a .22. Now I get to practice offhand at an indoor range (50 feet) using a smallbore target. The diameter of the black is 1 1/2 inches. If you can keep 'em in the black there, you'll be virtually guaranteed of mid 90's or better. You can also improve your ability to call your shots with the .22. Indoor ranges also mean year round shooting (particularly important if you don't live in sunny southern California), more available range hours and night shooting. The majority of my practice is at 50 yards (the black diameter is 2 7/8 inches which looks pretty darn small compared to the full length course target black). You can also shoot outdoors at 100 yards and get valuable practice reading the wind. As any competitive small bore shooter will tell you, the wind is every bit as tough at 100 with a small bore as it is at 600 with a service rifle - perhaps even tougher. You really have to pick up the subtleties in change in the mirage.

You also get to shoot more per session. Now I can go through 100 to 120 rounds of .22 easy as opposed to 60 to 70 shots per session of the real stuff. And you don't have to chase brass!

YOU'LL IMPROVE YOUR SHOOTING TECHNIQUE: This is the real kicker. The rimfire is unforgiving, much more so than centerfire. With it you'll better be able to study follow through, focus on trigger control, face pressure, grip and position. I have found it to be especially helpful with developing consistent shot follow through on standing. I have also noticed more concentration on trigger control during the rapids. Plus I've conditioned myself to smaller bullseyes so the real ones look nice and fat. That boosts my confidence. The best news is that all of this directly translates to better groups and better scores on the full length course.

YOU'LL HAVE MORE FUN: While I list fun last, it certainly shouldn't be least. In the past six months since I've been using the conversion kit I haven't had a bad practice yet. There have been sessions where I didn't shoot as well as I would have liked, but I had too much fun to be down about it. Now isn't that how shooting is supposed to be? At least it's food for thought.
Keep 'em in the black.

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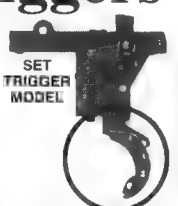

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HUNTING RIFLE ACCURACY

BY WILLIAM LAW HARTMAN

In the past few years I have been fortunate enough to hunt out west, and to be able to return on a regular basis. I wish I had been able to travel and hunt in the West when I was younger. In my case, and for those who didn't have the money, friends or family who lived in the West, or other connections, it just wasn't an option when trying to get started in a job and supporting a growing family. It was a question of waiting. But I am not alone. A number of others have had to wait for their chance to hunt in what many consider to be the premier hunting grounds of the North American continent. I wish I could say I had years of experience taking many head of game from mule deer, to antelope, to elk, to black bear, etc., but I can't. What I can say is that while I had to wait a long time to pursue my dream, in many ways it seems all the nicer because of the wait. I have also learned a few things that I think might help those who are also now able to hunt in the West for the first time.

Everyone interested in hunting has read the articles that regularly appear in the popular sporting publications on the performance of a particular rifle, read the endless design details of why a specific cartridge and load combination was used, the minute descriptions of just how the events of the hunt unfolded, and the tales of the outdoor writers who have hunted every single species of game on the face of the earth. I have to say it's difficult to relate. However, what I have learned, and what I think might help you too, are the following five things.

1. Have a good sling for your rifle. Not necessarily the kind you can lock your arm in, but the carrying kind. The number of sling designs over the years is probably less than the number of fishing lures that "guarantee to catch fish like crazy," but still a good number. There are cobra types, military types, types with all number of loops you can supposedly get into quickly, synthetics, leather, and so on. The reason the sling is so important is that you are usually going to have to carry your rifle for some distance. Seems obvious. What might not be so obvious is that you aren't used to carrying a rifle on a daily basis, and not in an altitude that is often several thousand feet higher than what you are used to, and with more sun from a different latitude coming through much drier air. This can get pretty tiring, even if you are in good physical shape. It is the difference in the location, a location you are not used to, not just the activity itself. You need a sling that is uncomplicated, durable, wide enough so it doesn't wear a groove in your shoulder, and yet stays in place and doesn't slide around.

Fortunately there is such a sling. It is the cotton web sling used by the military on the M-1 and M-14 rifles, and maybe other rifles I don't know about. Truly a superior item cheap, light weight, just the right width (1 1/4 inches), and with a coefficient of friction that makes it stick solidly to your shoulder whether wet or dry. I make two loops around the swivels using the military "double-box" keepers, but you can use any variation that suits you. I sew the ends (actually my wife does this for me) and then dip them in a good marine varnish to prevent unraveling, but if you didn't do this it wouldn't really matter. I know from carrying an M-1 rifle all over Fort Gordon, Georgia for five months in 1962-3, that this sling works. Carrying a rifle, even a reasonable weight sporter, is a lot of work—and it isn't just the weight either. Rifles are awkward. This might be part of the reason for the increasing interest in handgun hunting. No matter who you are, and what kind of shape you are in, you want to keep your stamina up as long as possible, not waste energy fighting with your rifle, and be ready for an accurate shot. The cotton web sling is a large step toward accomplishing this.

2. Settle on a single rifle for your hunting, and shoot in it only the load you plan on using for hunting. There are lots of really nice rifles available these days. Find or make one you really like and stick with it. Don't constantly chase after the perfect rifle. Remember that every engineering design, every design, whether it is an Indy car or a toothbrush, is a compromise. The absolutely perfect rifle, like the perfect dog or horse, is still out there somewhere and still out of reach. In my case I use a Bruno custom rifle with a Shilen barrel in .30 caliber I made about 11 years ago. The bullet that I found works best in terms of accuracy and knockdown power is the Nosler 165 grain partition. This is the only round I shoot in this rifle. They are not cheap, but using it in conditions other than out west gives me a feel for its performance that would be lacking otherwise. Find a bullet and load that works in your chosen rifle, don't change, and arrange to shoot it with some degree of regularity.

3. Make sure you have something soft (padding) on which to rest your rifle when you are ready to shoot. At the longer distances found out west, your best bet is to shoot from the prone position if at all possible, and in any case rest the rifle on the most solid thing you can find at the spot you are shooting from. Of course if you rest the rifle directly on a

hard surface, it will wobble and move. I put the forearm of my rifle on a pair of fleece-lined, leather gloves I got from L.L. Bean years ago, but anything will work: a day pack, soft hat, coat, whatever. Just make sure you have something handy you can get into use quickly.

4. Know the exterior ballistics for your rifle and load combination. Commit them to memory. This is a lot easier if you have been shooting only one load. Know without having to think, how much you are going to have hold over depending on where you have zeroed your rifle. Don't count on only shooting parallel to the surface of the earth either. Know that bullet drop will be lessened if you are shooting steeply up or down hill. If you are from the east, and think you are a pretty good judge of distance, be prepared to be faked out by the distances when you arrive out west. The scale is so vast, that it takes some doing to get used to. If you are hunting with a guide, listen to what he has to say. If you are hunting on your own spend a lot of time pacing off distances and see what they look like in your particular environment.

5. It is a truism that two things you should not skimp on are your optics and boots. Like rifles, there are many excellent riflescopes and binoculars available today. With a little diligence you can find good stuff.

Boots are another matter. While it may not be as obvious as to what they have to do with accuracy, they are as vital as anything. They need to be sized properly, well broken in, in excellent repair, and suited to the terrain and climate. In spite of all that has been written and said, too many people still get this wrong. If you are going to encounter snow and rain, you need waterproof. There is one material you can really count on for waterproof. Rubber. Gore-Tex and similar products can work, but back them up with rubber. On a horse-pack trip two years ago there was early snow, and several people were constantly trying to dry out wet leather boots, and were not very comfortable in between drying episodes. People try to do this with the camp stoves used to keep the tents or cabins warm, a risky procedure at best. Leather is obviously similar in composition to meat, and we all know the basic change that occurs to meat when it is cooked; it becomes tender. The outfitter told me after the season was finished that they had to pack out two individuals just two days into a wilderness elk hunt. One melted his brand new boots on the stove trying to dry them out.

It is worth knowing that the northern Rocky mountains are amazingly wet. Before packing in for the first time about seven years ago, I thought they would be relatively arid. But they're not. There is water leaking out of everything and everywhere. It was a surprise to me.

The reason for the emphasis on boots? If your feet are right, chances are good everything else will work right. If your feet are wrong, there is no amount or level of quality on any of your other equipment and gear that will make other things right-including accuracy.

This is a little different than the type of article you see when hunting accuracy is discussed. I do believe that if the five items are faithfully addressed, you will have all the accuracy needed to make a quality shot and participate in some of the finest hunting to be found anywhere. All the best.

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CONVERTING YOUR FRONT REST TO AN ADJUSTABLE TYPE

BY HARRY WEITZ

It has been many years since the first commercial tripod-type front bench rest made its appearance. The one I use now, a "Wichita" model, was purchased in January of 1973. Basically the design remained unchanged for many years, but within the last few years a significant number of improvements have been made.

One of these improvements, which has made a big improvement in my shooting, is the ability to make a set of side plates, or brackets, to squeeze the leather bag to make it conform better to the gunstock. Benchrest shooters who do not have this adjustable feature on their current rest can buy a replacement top, or you can use a conversion kit. The conversion kit shown in this article was built for less than $2.00 and works very well. It allows me to use my old, familiar equipment with the original front bag while making a really worthwhile improvement.

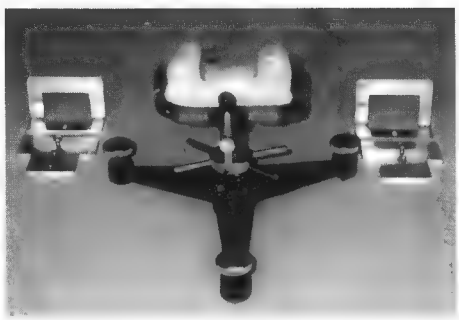
The design for this conversion kit is simplicity itself. It consists of four pieces of aluminum and six screws. If desired, the finished pieces can be painted to match the original color and texture of the rest. The material used is .189" (3/16 nominal) aluminum stock, 4" wide and 20" long. Use bendable alloys, no harder than 1/4 H with the grain running lengthwise. To form the "window" in the bracket (item 2), (if no other equipment is available), drill a series of 1/4" diameter holes, remove the webs and file smooth.

The cradle of the front rest is drilled and tapped for four #10-32 screws (two on each side.) The screws secure the cradle plates (item 1) to the underside of the cradle. The #10-32 holes are drilled and tapped along the centerline of the cradle.

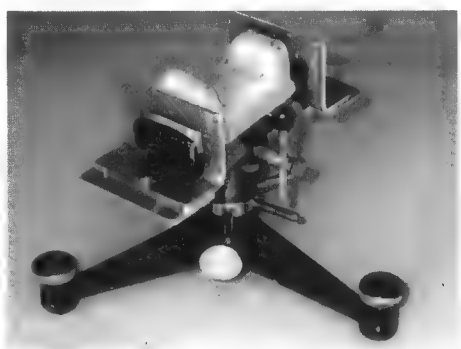
If a brake is not available to put the 90-degree bend in the brackets (item 2), use a stout vise. When using a brake or a vise, the 2-1/4" dimension should be in the jaws of the vise up to the bend line or in the gripper plate of the brake. Use large head, Allen-type screws for the maximum torque.

The minimum tools required are a good hacksaw blade (32 TPI), an electric drill, and a roughing and finishing file. Although I have expensive tools at my disposal, I built the set shown with this minimum equipment.

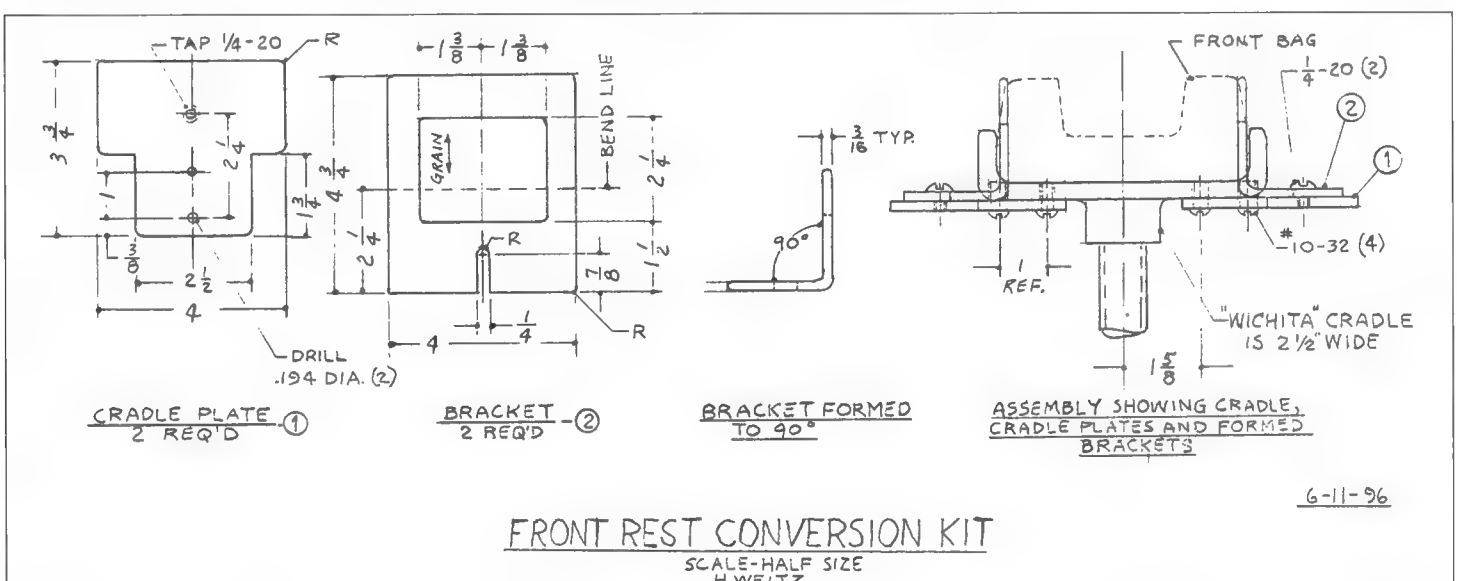
While the design shown is for the Wichita model rest, it would be easy to apply the principles of this design and the same features to any other model rest.



The four component parts of the kit together with the six screws are shown with the front rest.



The assembled conversion kit is shown on a Wichita model front rest.



MUZZLE MYTHS

BY LES BENGSTEN

One of the most commonly stated reasons for inaccuracy, especially a sudden loss of accuracy, is muzzle damage. For years, people have been advised to use special care in cleaning rifles from the muzzle end to avoid possible muzzle damage. It has even been written that wear from the rod rubbing against the muzzle would lead the rifle to become increasingly inaccurate. When I was in gunsmithing school, damage or wear to the muzzle was listed as a leading cause of inaccuracy in both handguns and rifles. It has been noted in countless articles in gun magazines over a number of years. The only problem with this seemingly self evident piece of truth is that it is completely false.

EARLY INVESTIGATIONS

I first ran across evidence that the muzzle might not be an important cause of inaccuracy when I read Townsend Whelen's autobiography "Mr. Rifleman". Around the turn of the century, Whelen had decided to test the then traditional wisdom that a damaged muzzle caused an inaccurate rifle. He took a single shot Winchester rifle in caliber .30-40 and belled the muzzle using a file. He found that the point of impact changed significantly, but not the group size. When, a number of years later I kept reading of the loss of accuracy due to cleaning rifles from the muzzle, I decided to repeat the tests using an '03A3 Springfield I was shortening the barrel on. I repeated Whelen's tests using a small, round file to cut grooves in the muzzle of the rifle. Then I fired several groups to check the effect of the new muzzle damage. After completion of that series of tests, I shortened the barrel an inch, recrowned it and repeated the tests. In both cases, I found that Whelen was probably correct. The point of impact shifted somewhat, but group size did not seem to be affected greatly. In both cases, the smallest group of the day was shot when the muzzle had been deformed the most. Probably this occurred because I was paying more attention to that particular string.

When I analyzed the results of that test, I was not completely satisfied. For one thing, I had only been using boat-tailed bullets. Would a flat based bullet react differently? My group size also varied about an inch. This could have been caused by the muzzle damage or the fact that I was using iron sights— the regular military rear sight in both tests, the issue sight for the first test and a commercial front sight for the second. Lastly, I had not evaluated the effect of a "ding" that forced metal up into the bore where it could scratch the base of a bullet. I thought this might be particularly significant when using a flat based bullet. With these thoughts in mind, I decided to do another, more complete, series of tests using a telescopic sighted rifle to cut down aiming error.

THE RIFLE

As a test bed, I chose another Springfield. This one was a Remington Model 1903. The barrel was removed and the bolt's locking lugs carefully lapped into full contact with the receiver. The front of the receiver was then faced off in the lathe to ensure that it was square and that the barrel would mate with even pressure when attached. I then fitted a good military '03 barrel made by Springfield Armory and bearing the date 6-42 and carefully headspaced it. Springfield barrels normally seem to be capable of shooting under two minutes of angle and I was interested in group size and point of impact change, not necessarily in squeezing the last 1/4" of possible accuracy out of it. Finally, the action was fitted to an old sporting type stock I had lying around the shop and the action glass bedded with the barrel being free floated. A Burris Mini-4X scope was installed using Weaver bases and Burris Zee Rings. This particular scope produces a clearer, sharper image than most scopes I have used. This would allow a smaller aiming point to be seen clearly and, hopefully, reduce aiming error.

THE AMMUNITION

Since consistency was of paramount importance, I used once fired LC-69 cases all trimmed to 2.484", the normal trim to length for the .30-06. The case mouth was then chamfered inside and out. The primer pockets were reamed and the flash holes reamed to .081". Lastly, I removed the small burr on the inside of the flash hole. With the cases as nearly perfect as I could get them with the tooling on hand, I primed them with Federal 210M Benchrest primers. For powder and load I chose IMR 4064 using 48.5 grains. This is the accuracy load listed in my old Lyman Reloading Handbook 45th Edition for the 165 grain bullet and has been my standard load for many years. I normally load the Sierra 165 grain boat-tailed spitzer bullet. Speer makes a 165 grain spitzer flat base which complemented the Sierra product for checking whether the results would vary depending on the shape of the bullet base.

TEST PROCEDURE

I decided to do side by side tests firing at two targets using the Sierra bullet on the left target and the Speer bullet on the right. The range was to be 100 yards. I chose 100 yards because most of the rifles that have to be cleaned from the muzzle are normally used for hunting at about that range. In fact, 100 yards is the longest shot I have ever taken at big game. My last two deer, taken in "the open west" were shot at under 75 yards. Thus, it seemed to me that this range would be long enough to produce valid

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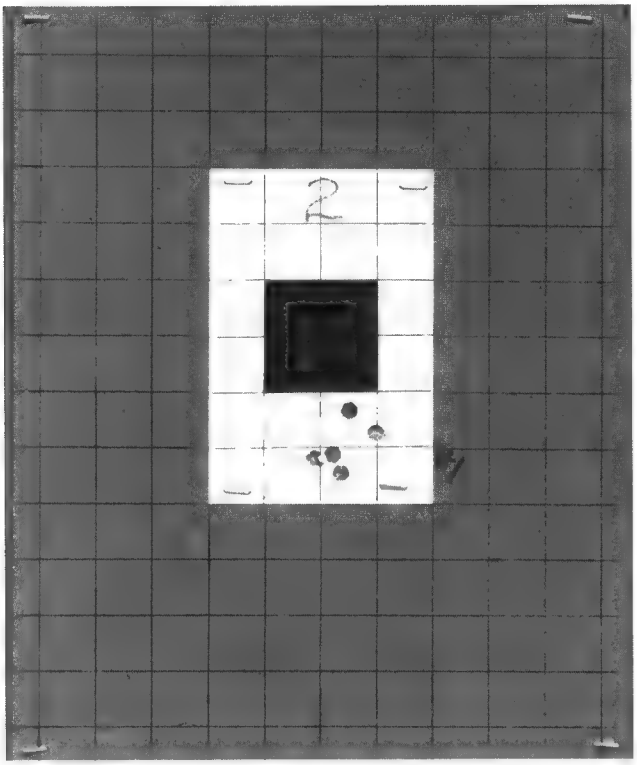

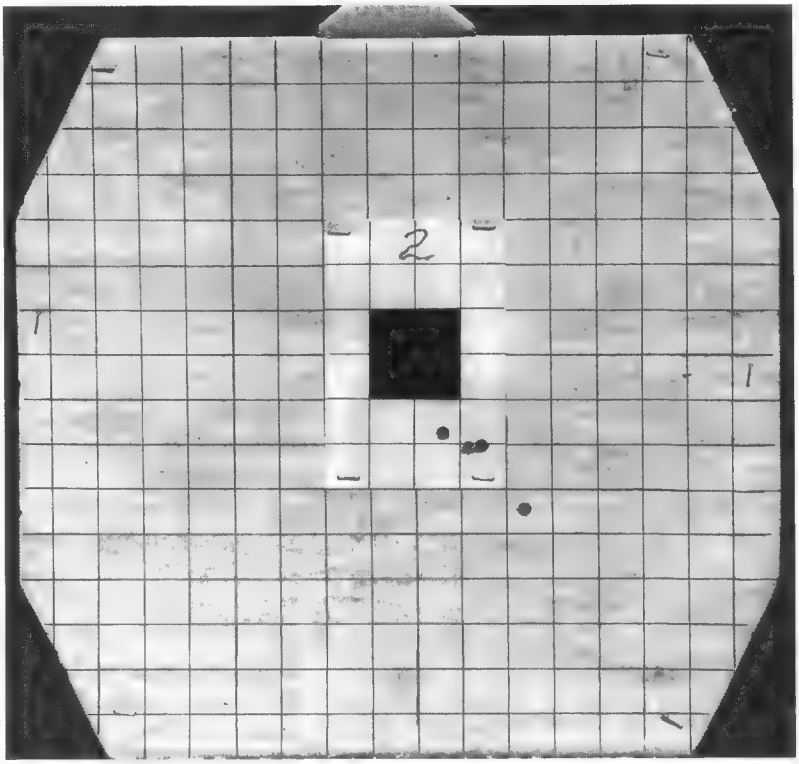

"Groups fired after first alteration of the muzzle. Sierra bullets on left (photo 1), Speer bullets on right (photo 2)"

Muzzle Myths *Continued*

test results and correlate closely with the most common hunting range.

For the actual shooting, I would use sandbag rests. While I am a fair shot, the point of this exercise was to see how well the rifle would shoot, not how well I could shoot. To this end I also enlisted Kent Singletary, a fellow gunsmith as observer. Kent would watch through a spotting scope and observe the impact of each shot and then record it on a sketch of the target. Shots that I called as flyers would be noted and not figured into the group size. Shots that were not called flyers, but were out of the group would be counted for overall group size on the theory that the deviations probably had been caused by the deformation of the muzzle. This procedure may have been too conservative, since there were two instances where the group was opened up by one shot while the other shots formed a concentric group. I decided to shoot five shot groups. This is the smallest number of shots I have found to give a true reading of a rifle's grouping capability. Ten shot groups may have been better, but I was testing hunting performance, not target rifle performance. Besides, even with rifles in the .30-06 class, shooting off a bench rest becomes unpleasant when shooting long strings.

TEST RESULTS

The rifle was carefully sighted in using my standard handloads to establish standard group size. These were not specially prepared loads, but were carefully assembled as is all my hunting ammunition. They are normally capable of shooting into less than one minute of angle in rifles that will shoot that well. The groups ran 1 5/8", 3 1/4", 3/4" and 1 1/4". Except for the second group, which one flyer opened up from 1 1/4", the rifle seemed both accurate and consistent. All of the groups, except number two were evenly clustered.

Test 1

The rifle was fired for group with the test ammunition. Its muzzle not deformed. Both groups were about 1" lower than sight in load and 1" right. Group size was 7/8" for the Sierra bullet and 2 3/8" for the Speer. New target center put up.

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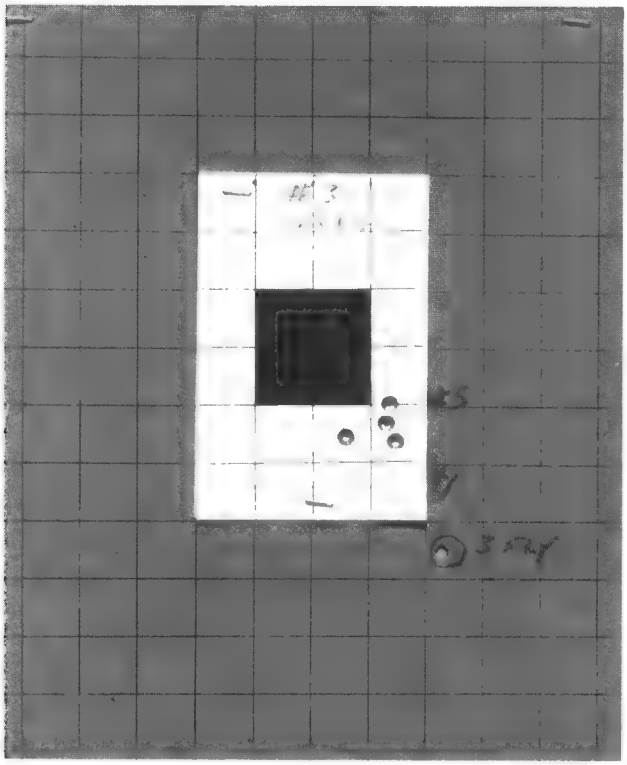

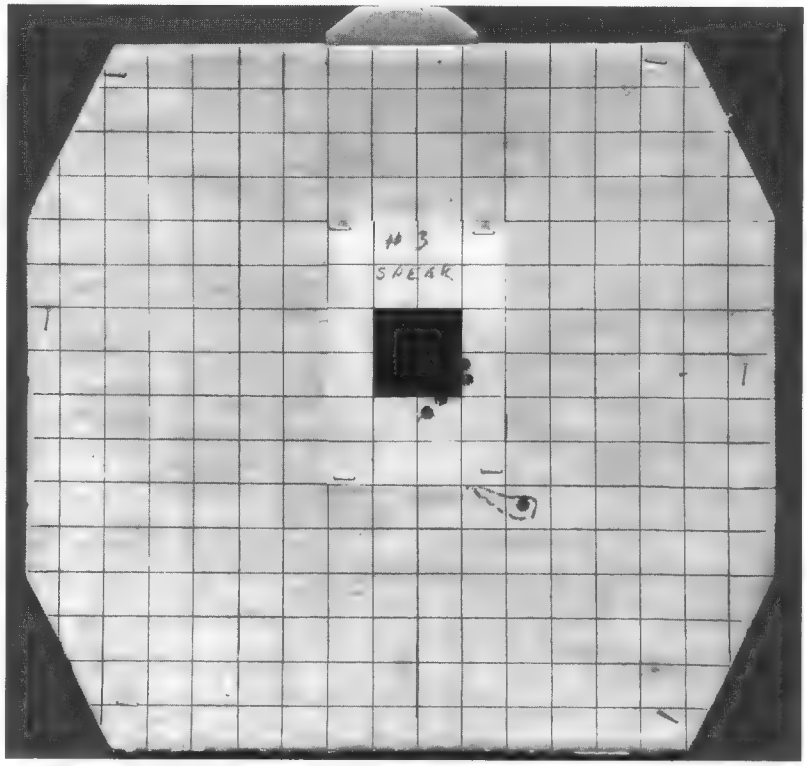

"Groups fired after second alteration of muzzle. Sierra bullets on left (photo 3) with one called flyer, Speer bullets on right (photo 4)."

Test 2

A groove was filed in the muzzle at the 3 O'clock position as viewed from the muzzle end. The Sierra bullets produced a 1 1/4" group with the center of impact shifted 3/4" to the left of the previous group. The Speer bullets produced 3 1/2" group about the same point of impact as the first group. New target center put up.

Test 3

A groove was filed at the 12 O'clock position. The Sierra bullets produced a group of 7/8" with one called flyer opening it to 2 1/2". Center of impact was about the same as in test 1. The Speer bullets produced 1 3/8" group that was centered about 1/2" higher than test 1. Target center replaced.

Test 4

A wide groove was cut in the muzzle at the 9 O'clock position as viewed from the muzzle end. This simulated years of cleaning from the muzzle using an uncleaned rod that was allowed to scrape against the muzzle. The Sierra bullets

Continued on page 69

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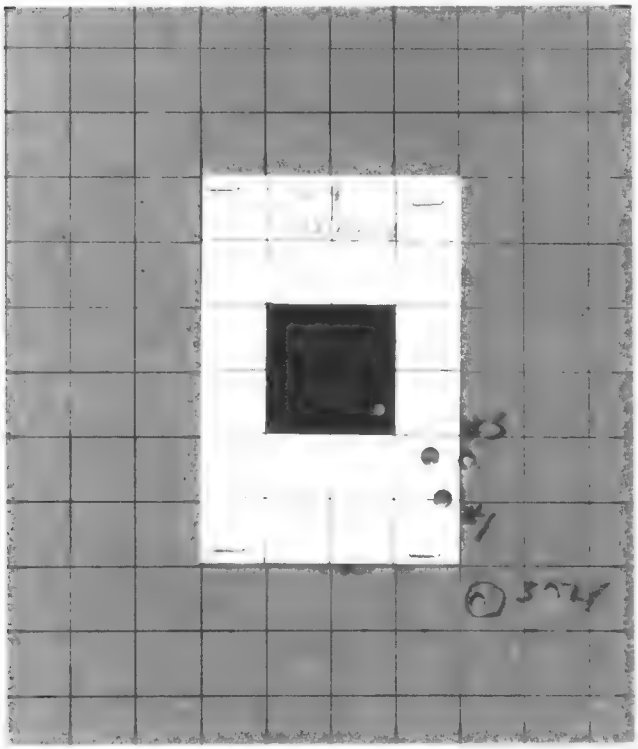
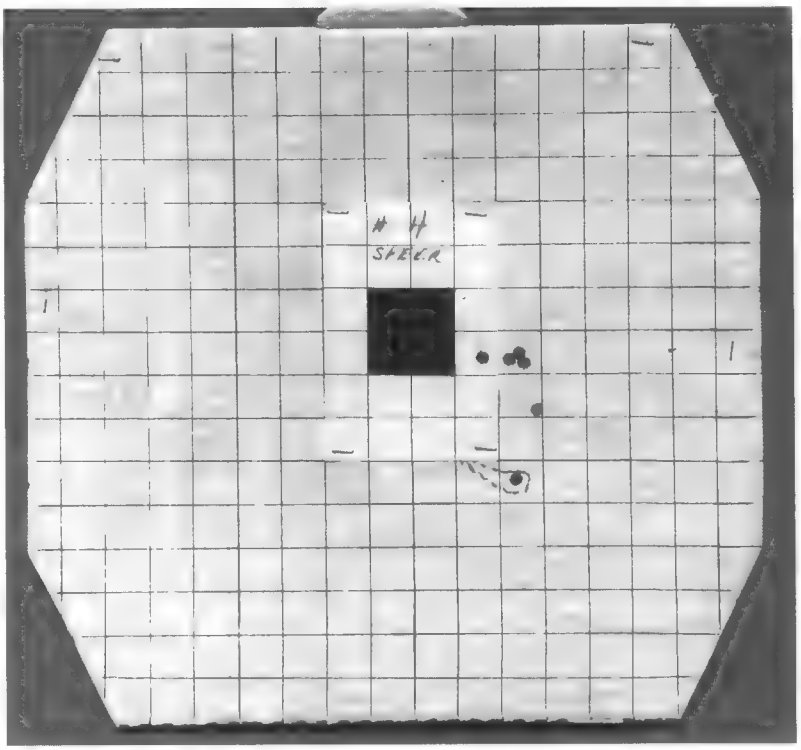
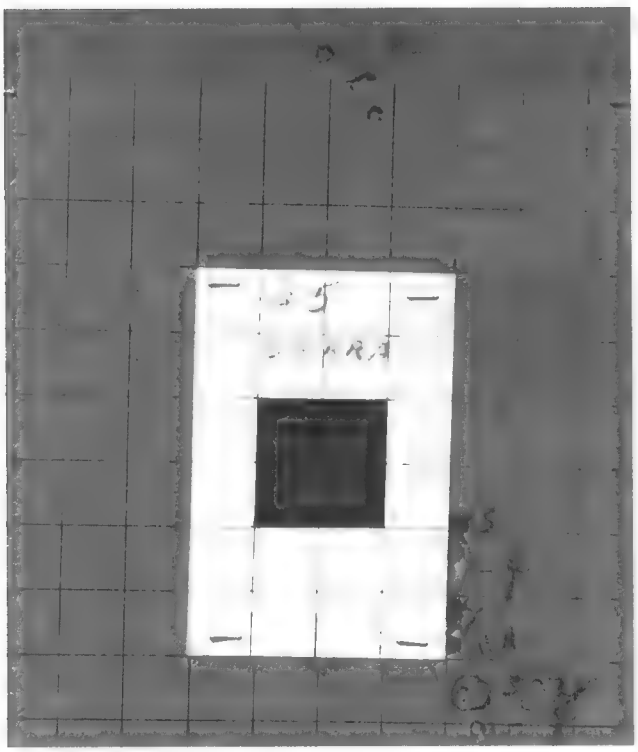
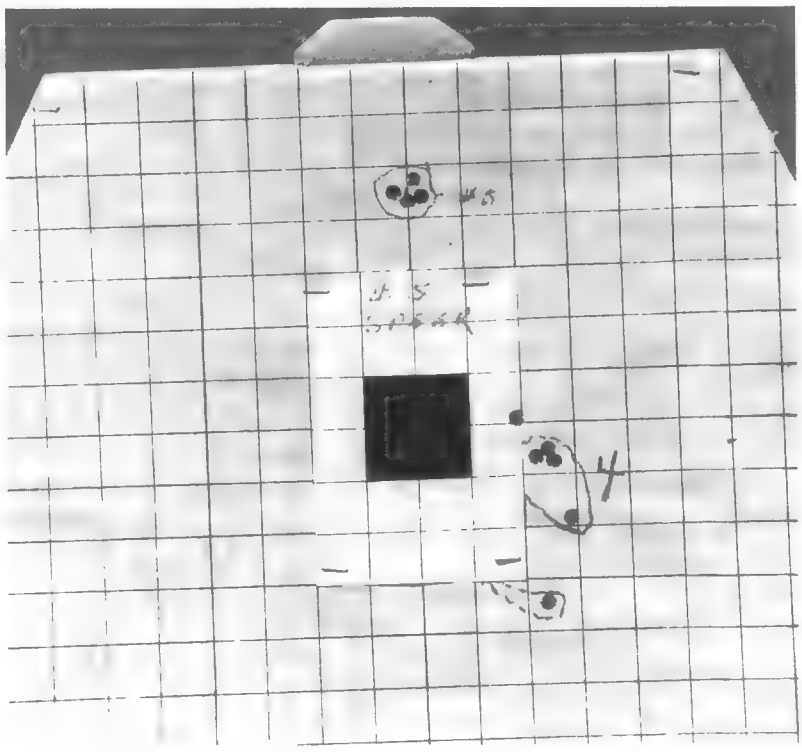


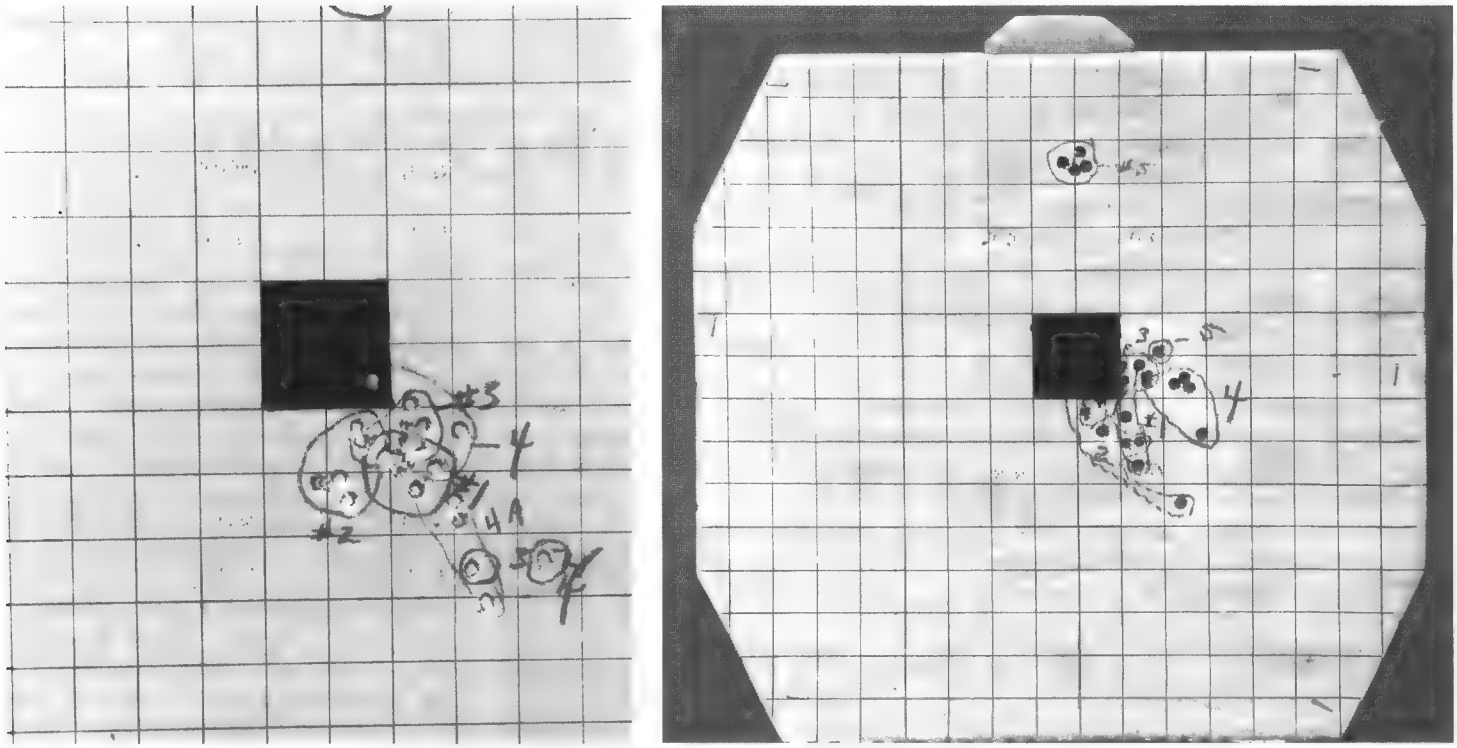


"Groups fired after third alteration of muzzle. This alteration caused significant damage to muzzle simulating many years of cleaning rod abrasion. Sierra bullets on left (photo 5) had one uncalled flyer that opened group significantly. Speer bullets on right (photo 6)."





"Groups fired after a "ding" was raised in the muzzle that intruded into the bore area scratching the side of the bullet. Both groups were significantly higher than previous groups in the direction of the deformation, but group size was stable. Sierra bullets on the left (photo 7) and Speer bullets on the right (photo 8)."



"Targets after test completion with Sierra bullets on left (photo 9) and Speer bullets on right (photo 10). Except for the "ding" in the muzzle, none of the damage to the muzzle would cause you to miss a deer at 100 yards."

Muzzle Myths

Continued

produced a 3" group with the first shot 2" lower and to the right of the main group. This portion of the test was performed again with the first shot called a flyer. The group ran 1 1/2" with the flyer opening the group to 2 3/4". The first shot in both cases was to the low right. The Speer bullets fired a 1 3/4" group. Both bullets grouped in approximately the same place as test 1.

Test 5

For this test, a burr was raised in the muzzle at the 6 O'clock position. The burr intruded into the barrel at the junction of one land and groove. This simulated the rifle being dropped and impacting on a stone when out hunting. The Sierra bullets fired a 2 1/8" group and were 8" higher and 1" to the left of test 1. The Speer bullets fired their best group of the day- 1/2", not counting the first shot, a called flyer. The group was 6" higher and 1" left of test 1.

Continued on next page

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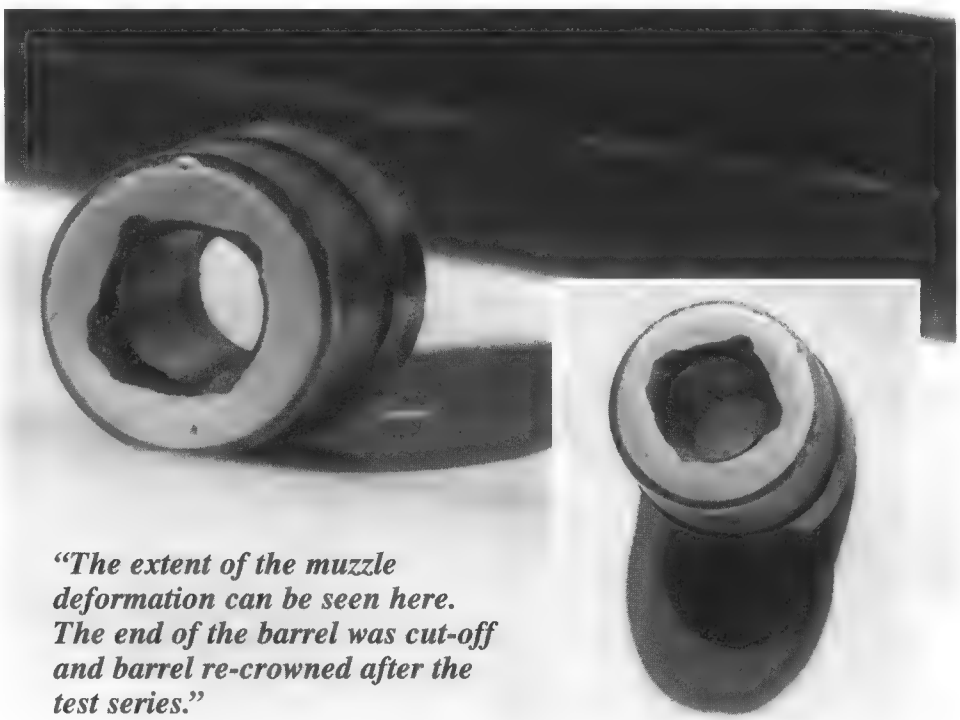


"The extent of the muzzle deformation can be seen here. The end of the barrel was cut-off and barrel re-crowned after the test series."

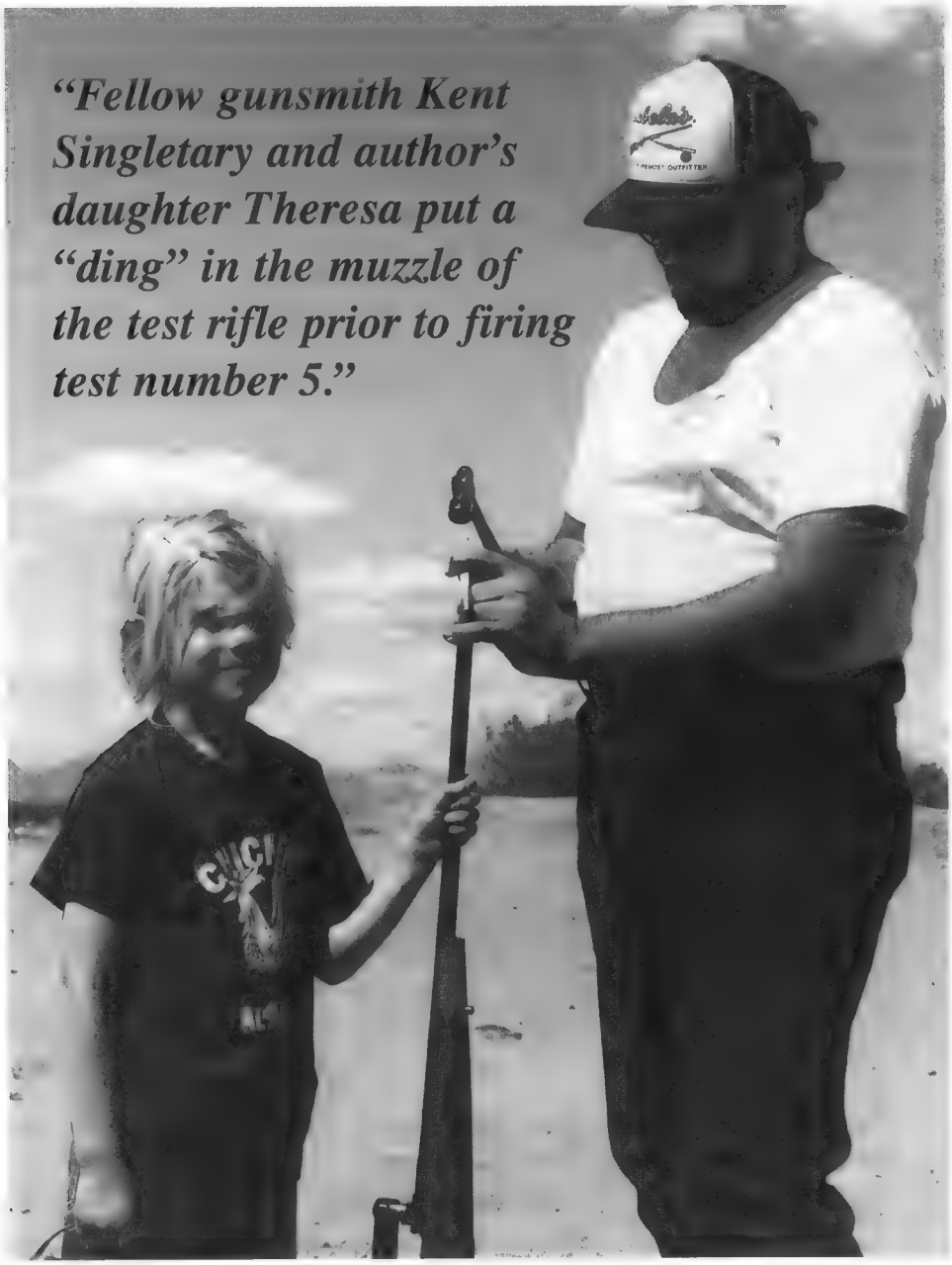
Muzzle Myths

Continued

Analysis

It would seem that the conventional wisdom that muzzle damage is a valid cause of inaccuracy is certainly very suspect if not completely untrue. It is interesting that the Speer bullets actually seemed to perform better when there was extensive muzzle damage. It is also significant that the TOTAL group size for the first four tests ran under 4" in spite of the fact that major alterations to the muzzle had taken place. The only damage to the muzzle that seemed to have a significant effect was when a burr was introduced. Then it affected bullet point of impact, not group size (while the last group with Sierra bullets was larger than the average, the first four shots went into 1/2" and the fifth shot may have been an uncalled flyer). It would seem that the crown of the muzzle may be more of an aesthetic habit than a ballistic necessity. As long as there is sufficient crown to prevent the muzzle from being easily damaged if accidentally dropped, the exact form is merely cosmetic.

There are still further tests to be performed. Would a different caliber or a different bullet weight produce the same results? Would another rifle prefer the Speer bullets to the Sierra bullets? A follow up test to see whether the initial results of test 5 (where a dent or ding causes an intrusion into the muzzle) really does not affect the accuracy needs to be performed. In the final analysis, however, Townsend Whelen's test of possible inaccuracy caused by muzzle wear has been scientifically examined, and expanded, in a manner that can be duplicated by anyone interested in replicating such a test. It should also lay to rest the general wisdom that cleaning a rifle from the muzzle will lead to inaccuracy, at least as far as hunting rifles are concerned. It may cause a change in point of impact, but that change is gradual. It is also less severe than the change in point of impact that can be obtained by merely changing brands of ammunition. Townsend Whelen was noted among the shooting writers of his day for being unerringly accurate in his reporting of tests and their results. It is a pleasure to reconfirm that fact in this instance.



"Fellow gunsmith Kent Singletary and author's daughter Theresa put a "ding" in the muzzle of the test rifle prior to firing test number 5."

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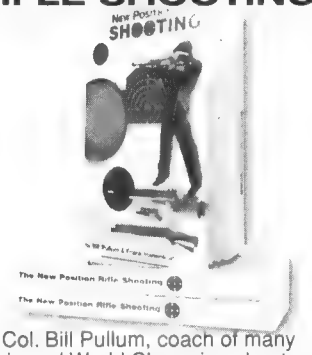

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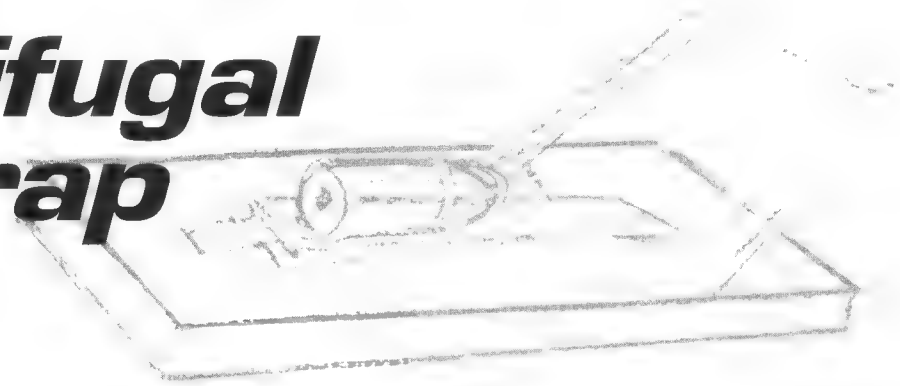
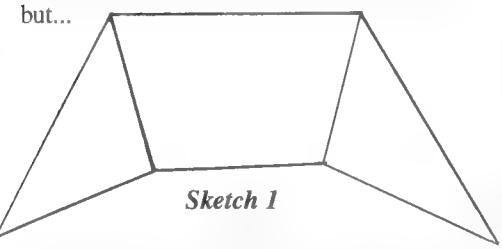
A Centrifugal Bullet Trap



BY LONNIE BOYD

Since the first time I fired a rifle, I have been trying to improve my skills with that instrument. Any number of things have been tried, such as better sights, different types of targets, new or better methods of holding and aiming. Probably the most important of all the things I tried was just plain old practice. Living in a rural area I could enjoy my hobby right in my own back yard. Since there were neighbors within range of the firearms I was using, a bullet stop of some sort was needed. My first backstop was simply a flat sheet of steel of an appropriate size and thickness set at an angle to deflect the projectiles into the ground. Wings were welded to each end in such a manner as to hold it at the correct angle and herd any wide shots into the back of the stop. (Sketch number one) It worked, but...



Sketch 1

Since I cast my own bullets, I got tired of sifting the lead from the earth and started looking for a way to catch the bullets before they came into contact with the ground. A friend and shooting buddy told me of an idea he had read about somewhere or other. Use an old tractor tire with a steel plate bolted over the opening of one side of the tire. (Sketch number two) Shooting into the open side against the plate would cause the soft lead bullets to spatter in all directions and be collected by the tire. It worked, but... When the lead was retrieved and melted down there was always the smell of burning rubber. It seems the bullets would abrade the inside of the tire and particles of rubber would mingle with the collected lead. There was also a problem of rebound. Some of the lead particles would bounce out of the front of the trap and fall to the ground. The tire was just deep enough to prevent this from happening. "Well", I thought, "The idea works; all I need now is to eliminate the rubber tire."

One day I drove past a local machine shop and spotted a cone shaped piece of steel about four feet long and two feet in diameter at the large end. It tapered to about six inches at the small end. When I asked if it and some other things that I saw in the yard were for sale, I got affirmative answers. I felt my problem was solved ! One of the items was a section of steel pipe about two feet in diameter. This would serve the same purpose as the tire, to collect the spatter. I put it all together in the form indicated in sketch number three. An access hole with cover was put into the bottom of the collector to retrieve the lead. Yes, it worked, but. There was still a rebound of particles out of the front of the trap !

By nature I am a tenacious person; I did not give up. I kept an open mind and waited. Sometime later I read an article about a new lead collecting device used at indoor ranges. This trap had a centrifugal catch system that used oil to control lead dust created by bullet impact. That article started my old brain working on a new idea and as time went by a new form of trap began to take shape in my mind. The principle was simple: a policeman's whistle. That's right a policeman's whistle! Just lay it on it's side, open the end you blow through, close the opening that creates the sound and add a collector at the bottom! (Simple, isn't it, Dave?)

All I needed at this point were the materials to build it from. As luck would have it, there was a pipe factory on a highway that I traveled regularly. On one such trip I stopped there and asked about some of their large diameter pipe. Again, luck was there for me. I was given two pieces of scrap pipe that would serve very nicely, thank you. One was fourteen inches in diameter and the other was sixteen.

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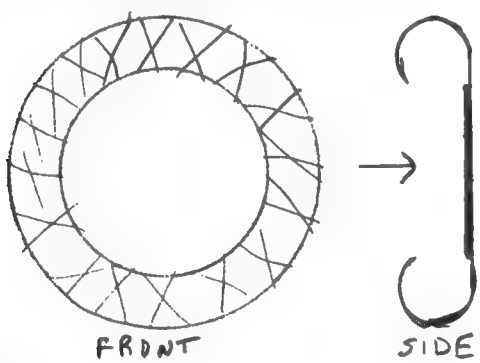
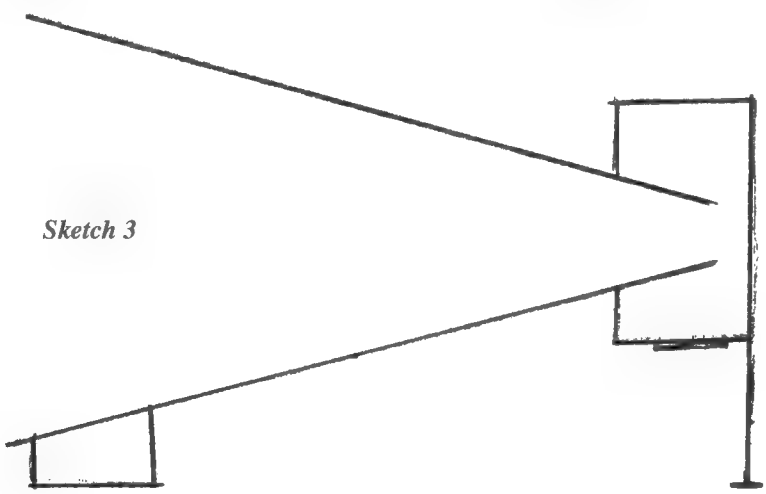


Sketch 2



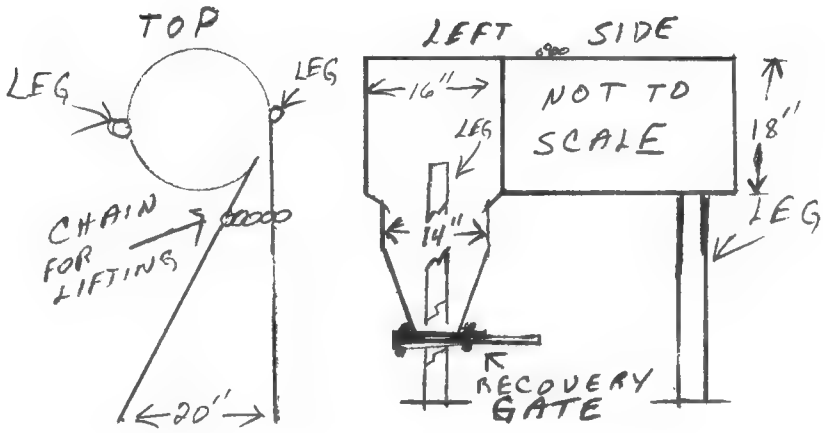
Sketch 3

A Centrifugal Bullet Trap
Continued

(You know, Yankee ingenuity in a southerner is a wonder in itself.) It seems that I possess just a smidgen of it because I was able to make those two pieces of pipe do the job. Please refer to sketch number four as you follow this and maybe it will all become clear. I calculated the amount of opening I needed to shoot into and arrived at a 20 inch wide by a 18 inch high window. This was determined by the size targets I was using. I then figured the size and amount of steel plate I would need to create these dimensions. I chose 3/8 inch thick plate to prevent piercing by the ammo I was going to use. The sixteen inch pipe is 5/16 inch thick, so I chose it for the top section of the trap. The fourteen incher was consigned to the collector section as it was only 1/4 inch thick.

Target window height, fixed at 18 inches, dictated the length of the upper pipe; it was cut at 18 inches also. I then made a lengthwise cut in the pipe. To one edge of this cut I welded a 3/8 x 18 x 39 inch steel plate to form the right side of the deflector box. Another steel plate, 3/8 x 18 x 29 inches, was welded to the other side of the cut to form the left side. The opening between the two (the entry to the trap) was adjusted to about an inch and the wings adjusted to the 20 inch width before this weld was made. With this accomplished, I placed it on another steel plate and drew the outline for the top cover which I cut out and welded in place. The bottom of the deflector box was then cut and welded in place. It was the same as the top minus the circular portion that covered the pipe.

It would have been easier had my pipe been long enough to make the upper and lower sections from one piece. Since it was not, the smaller diameter section had to be cut and flared to fit the larger diameter of the upper section. After fitting the two together and welding in place I proceeded to form a cone from the lower half of the bottom section. Vee-shaped sections were cut from it so the sides could be folded together to form the cone. I then welded a plate to the bottom of the cone. This plate had a hole cut into it to match the diameter of the open end of the cone. Another plate was cut to match but without the hole and with the addition of a handle. Matching holes were drilled on

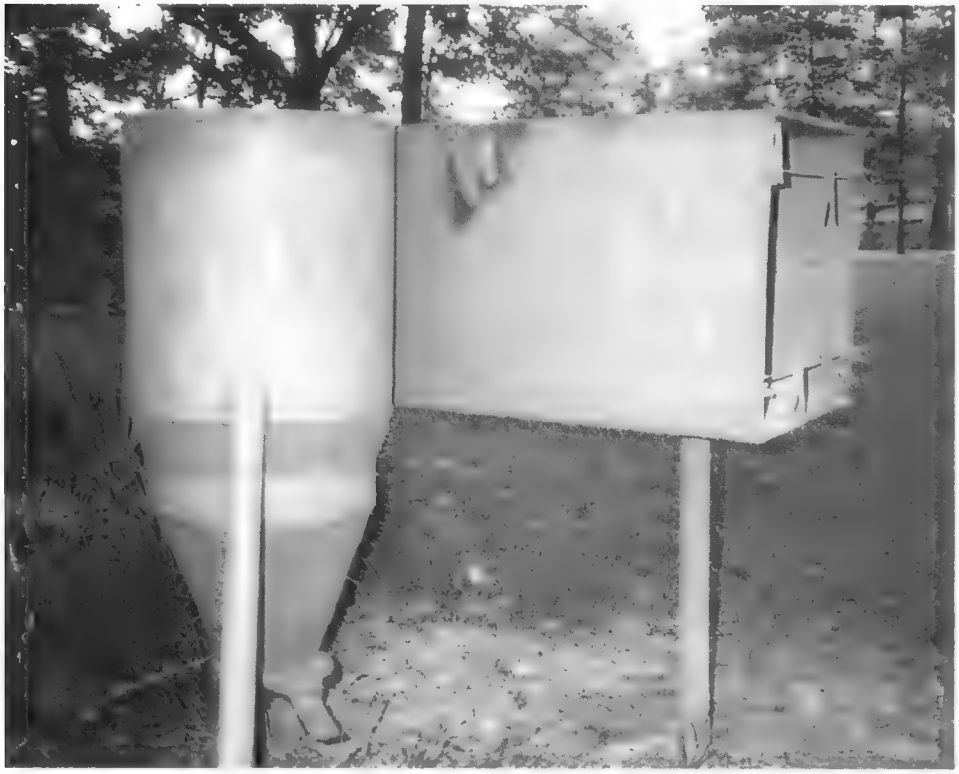


Sketch 4

each side of these plates. With the addition of a couple of bolts, one for a pivot and one to lock it in place, a gate was formed to retrieve the lead. (photo #1) That completed the centrifugal bullet trap. (photo #2) After the addition of three legs (overall height is 43 inches) and the welding of a chain to the top to provide a lifting purchase, a coat of paint was applied. I found that the legs needed a pad of about six inches in diameter to prevent sinking into the ground when it rained. This little son of a gun is heavy!

Four holes were drilled in the deflector. One drilled on each side, three inches from the top and on each side, three inches from the bottom about 1/2 inch from the edge. These were tapped 1/4 x

Lead Recovery Gate



20 and 1 1/2 inch screws into them from the inside. This left about an inch protruding to the outside to tie a length of nylon cord across the top and bottom of the opening. Add the appropriate number of clothes pins and target hanging is taken care of.

With environmental controls and regulations, and health concerns about lead in the ground, a bullet trap is nice to have in my back yard. Being able to retrieve and recycle the lead is a plus also. Did it work? Yes!!!!!!!! No more lead spatter out the front. It will stop any .22 lr from handgun or rifle. I have also shot hand gun calibers of .38 special., .357 magnum jacketed hollow points, .40 S&W, .45acp 230 grain hard ball, and .45ACP 185 grain lead. (my apologies Dave, I know that I've slipped over the line and now I am talking "pistols". These were only quoted to indicate the stopping ability of the trap!) A word of caution here — high velocity jacketed rifle bullets will penetrate mild steel plate like a hot knife through warm butter, especially at close range!!! The angle of impact doesn't seem to matter. Trust me, if the first round doesn't penetrate, subsequent rounds will, if impacted in the same place.

My apologies for not having a price estimate on the materials. Everything I used was either donated to me or retrieved from scrap. Costs can be cut somewhat by using lighter steel for the top and bottom pieces of the deflector. The major force of impact is absorbed by the two side plates and the round chamber formed by the pipe at the rear of the trap. BR-50 shooters should be able to get maximum use from a trap of this type. Distance required is not too great and the accuracy of the rifles would certainly direct all shots to the confines of the deflector. Although I haven't tested this, schuetzen rifle shooters should be able to utilize it also. Lead bullets at 2000 fps or less would pose no problems at say one hundred yards or more.

Well, there it is. Have fun. Be careful.

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Notes on Bullet Yaw or: It's Done with Mirrors

Synopsis:
Recently Norma Precision's ballisticians photographed selected bullets in flight. These photographs clearly demonstrate the characteristic yaw associated with early external ballistic flight of many bullets. These prints also show the turbulent wakes behind these supersonic bullets and that a boattail reduces the magnitude of that wake. Other important effects are evident.

BY M.L. MCPHERSON

So you want to take a picture of a bullet in flight? Well, friends, this can be done but it does involve solving a few problems, which requires a bit of special equipment. The basic setup utilizes a camera with an open shutter in a darkened room, a triggering device to sense the bullet's presence (which cannot use light), and an extremely bright and extremely high-speed strobe light. Once this system is properly established, the only limitation to the resulting photograph's quality lies in the duration and brightness of the flash of light provided by the strobe — shorter and brighter is best.

Norma has improved upon this basic concept by adding a mirror to the system so that the resulting pictures show the bullets from perpendicular (right-angle) perspectives. This little touch is quite valuable for analysis of bullet yaw. Given only one perspective view, we could see any of the following in any given photograph: 100% of actual yaw, 0% of actual yaw or anything between those extremes. What the photograph showed would depend upon which direction the bullet's nose happened to be tilted at the instant of the strobe's flash. The only way we could accurately resolve actual yaw would be to compare the bullet's apparent length to its actual length, essentially impossible to do accurately. However, with perpendicular perspectives we only have to use a bit of simple math (trigonometry) to calculate actual yaw angle.

For example, if one perspective showed zero yaw we would know that the other perspective showed actual yaw. Conversely, if both perspectives showed the same yaw angle we would know that the bullet was tipped at either 45º or 135º to the perspective views and that actual yaw was the square root of two (2) times apparent yaw (apparent yaw (cosine 45º). For a typical situation, where both perspectives showed some yaw but the amounts were different, the analysis is a bit more complicated but it is still "simple" math.

The amount of yaw can be useful information as it can suggest accuracy potential of a load combination. It is also quite interesting to note yaw differences between bullet types. In the associated photographs, identical loads were used with six different bullets. There were several shots fired with each bullet but the results of each shot in those sets were essentially similar — an important point that we will return to later. Conversely, there were clear yaw differences between these various bullet types. For my purposes in this analysis, I will neither measure apparent yaw nor attempt to calculate actual yaw, but only observe apparent differences.

I will note that bullets with excessive initial yaw are not likely to produce match-winning accuracy. Excessive initial yaw might suggest marginal stabilization or a bad combination of barrel time and vibrational harmonics (often it simply indicates a bad barrel crown) — if the gun's muzzle is experiencing a vibrational reversal as the bullet exits, the muzzle could push the bullet's base out of alignment with its axis of rotation, which would induce yaw. Remember that the speed of sound in steel, which is the

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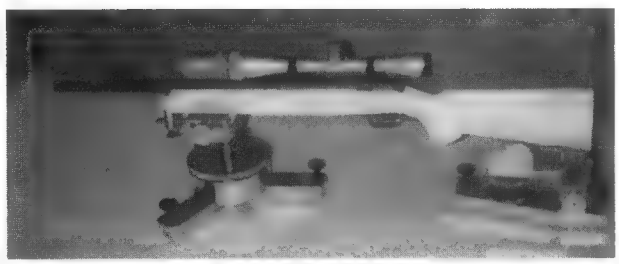

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velocity that vibrational waves can travel through steel, exceeds 10,000 fps. Yes, the end of the barrel can easily be whipping fast enough to upset the bullet.

The second interesting thing clearly shown in these photographs is the vapor trail behind each bullet. Since all these bullets were fired under the same (controlled) atmospheric conditions and at essentially the same velocity, variations in character of these vapor trails (which looks like boiling water in the photographs) might suggest variations in bullet stability. One photograph (#5) shows a dramatic variation in this trail. This is also the bullet type that showed the greatest angle of yaw.

This turbulent wake also clearly shows that the boattail is effective in reducing turbulent drag. The beginning of the wake, directly behind the bullet, is the same size as the boattail's flat base — as the bullet passes, air follows the boattail's tapered portion without separating from the bullet until the flat base passes. With less turbulence behind the bullet, wind resistance is reduced. YES, the boattail reduces drag, even in supersonic projectiles.

Photographs three (3) and five (5) show another interesting effect. Directly behind the initial sonic shock wave is a second, smaller shock wave. This feature suggests some sort of imperfection in these bullets' noses. If I didn't know better I would say these were standard spitzer bullets and that the second shock wave corresponded to the juncture of the jacket and the exposed core. However, these are both JHP bullet types so this shock wave must reflect some imperfection in the jacket either in shape or in surface finish.

All these photographs also show minute shock waves associated with the rifling engraved along the bullet's shank. Interestingly, these turbulent features are not equally developed with each type of bullet. This likely suggests variations in character of rifling engravement in the jacket. Sharper engraved edges can result from a harder bullet core or a thicker jacket. Sharper edges will create more distinct shock waves. Referring to Mr. Berger's (Berger Bullets) observation that recovered moly-plated match bullets show shallower and smoother rifling engraving, compared to otherwise identical unplated bullets fired from the same gun with the

Continued on next page

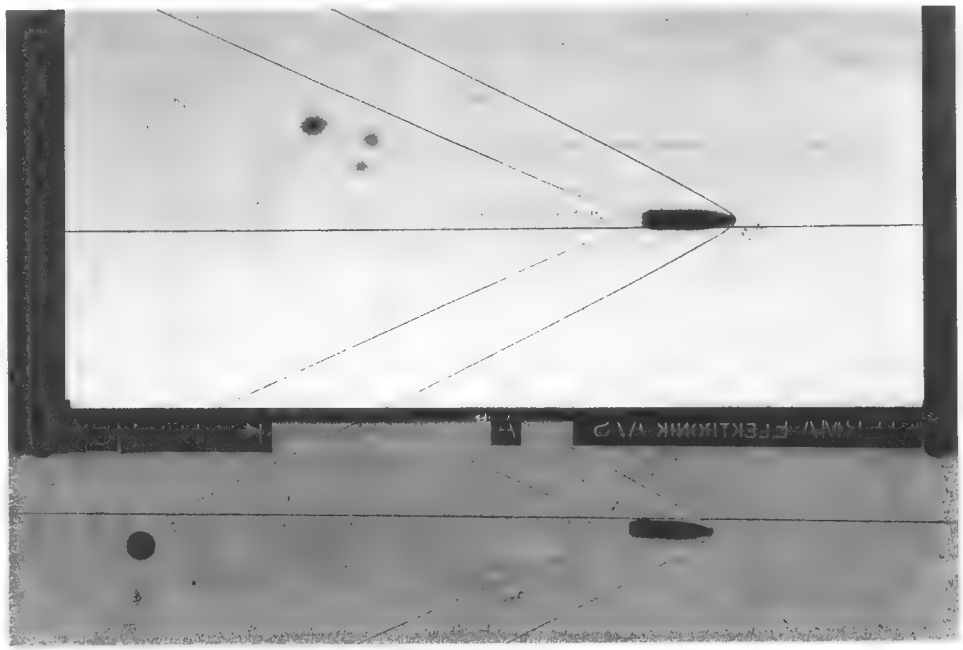


Photo 1: Bullet Type A: In the upper image, this bullet appears almost perfectly point on. However, note that the lower (right-angle perspective view) shows obvious yaw, the bullet's nose is tilted away from the flight path line. True yaw angle is just about what is shown in the lower image. Note the vapor trail behind this bullet (looks like boiling water). Directly behind this bullet this feature is no bigger than the flat portion of the boattail. It also disperses quite smoothly. Other interesting effects are visible (see other photographs).

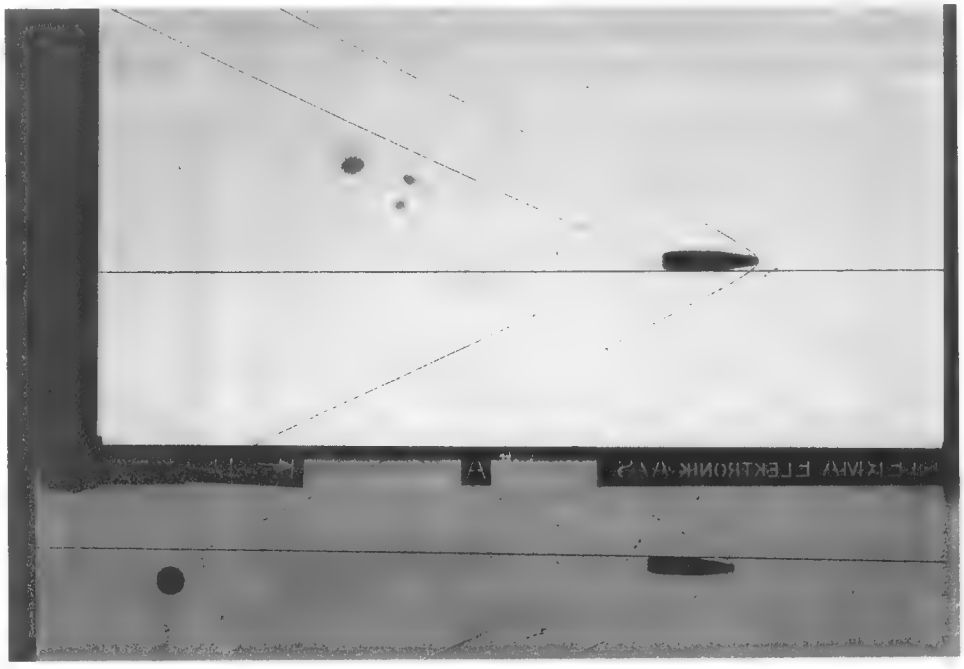
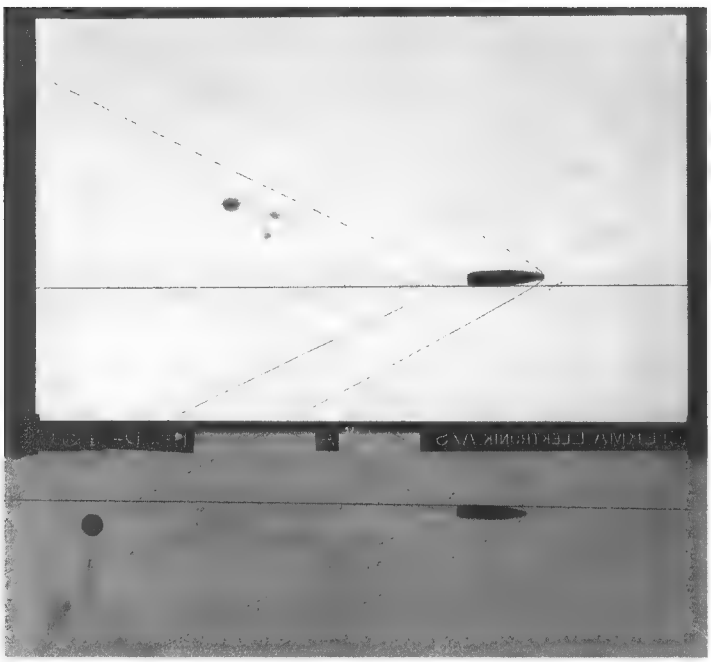
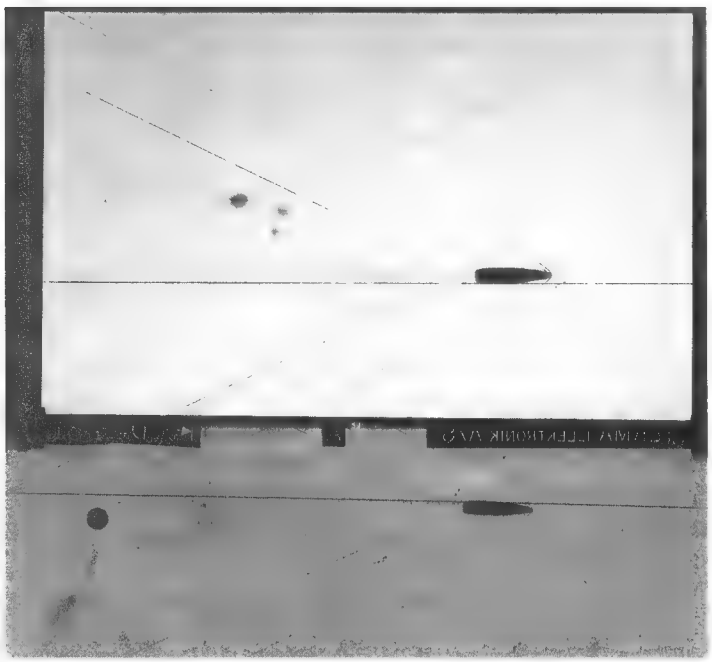


Photo 3: Bullet Type B: In the upper image this bullet appears slightly tipped with relation to the line indicating direction of flight (the nose is tilted slightly up at the front). In the lower, right-angle perspective view, the nose shows more yaw. True yaw is slightly greater than what is shown in the lower image. Using a bit of math we could work out actual yaw. This picture also clearly shows well developed shock waves just behind the primary shock wave (see text). Note other features along the bullet's shank and fanning away from the boattail section. The former relate to disturbances of the passing air caused by the rifling. The latter relates to reduced air pressure in that zone — as the air follows the receding boattail, surface pressure is reduced.

Notes on Bullet Yaw
Continued





Photo's 5 & 6: Bullet Type C: Note the significant and similar yaw in both of these photographs. Other effects are interesting. First, the vapor trail shows that the bullet bases are following a curved path — in the upper image in photograph 5 this is quite clear, the vapor trail is mostly below the line at the left side. Also, both bullets are tipped about the same amount and in about the same orientation (see text). The vapor trails appear somewhat more choppy, compared to the other bullets. Finally, the primary shock wave reflects yaw; this feature is not equally distinct on both sides of these bullets (see text).

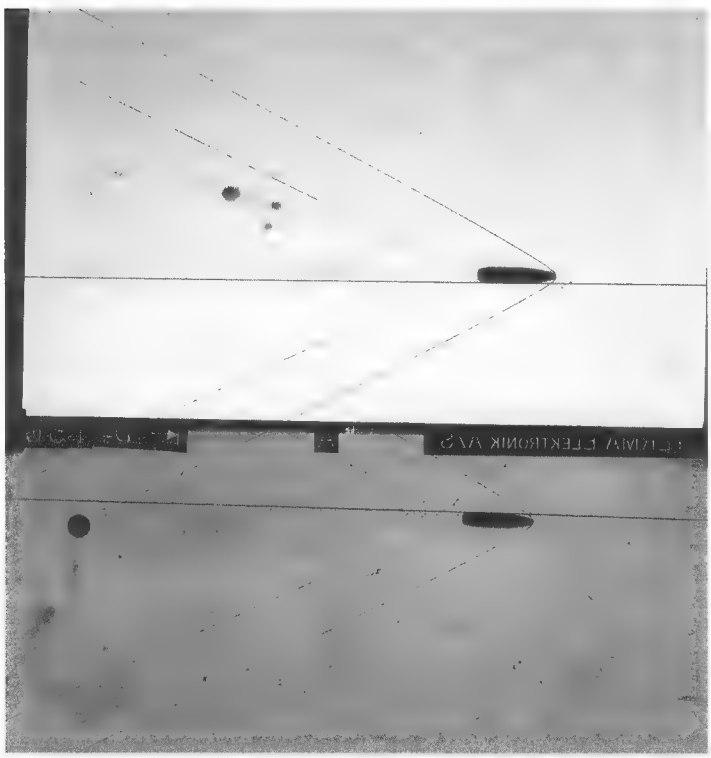


Photo 7: Bullet Type D: Note obvious curvature to the primary shock wave near the bullet's tip. This reflects increased air pressure in that zone.

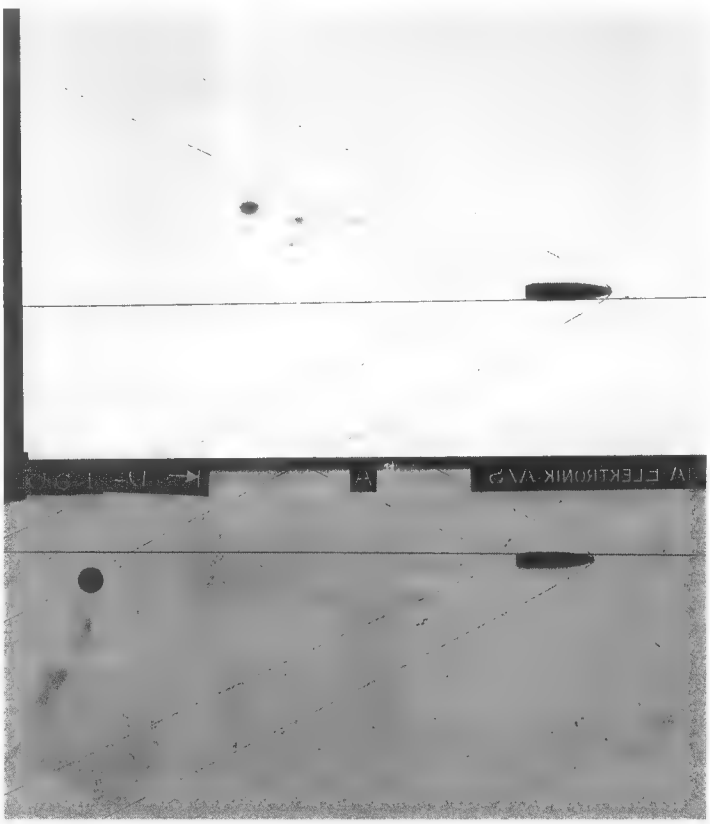


Photo 10: Bullet Type E: This bullet shows very little yaw.

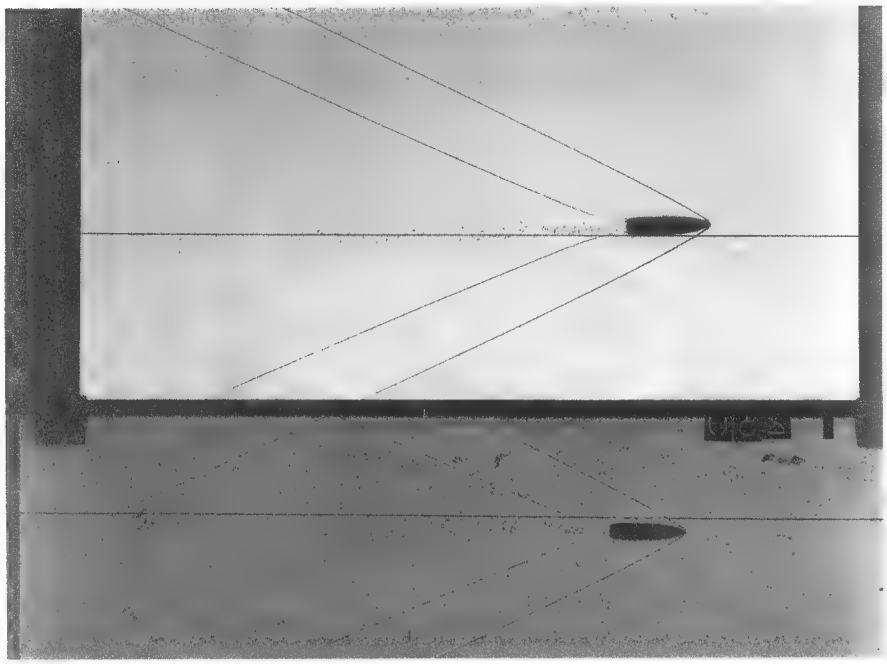


Photo 12: Bullet Type F: This bullet shows a serious case of yaw and a wildly crooked flight path. Note how far the lower image is from the flight path line.

same load; this fact might very well explain why moly-plated bullets can shoot flatter at long range!

Also interesting is the fact that both sides on the primary shock wave are not equally distinct in some of these photographs. This effect is related to yaw. When the bullet's tip is tilted toward one side, the shock wave is less distinct there because that side of the bullet's nose is effectively sharper.

Quite noteworthy is the fact that all the bullets showing visible yaw are essentially equally tipped and in the same orientation in each set of photographs for that bullet type; see photographs five (5) and six (6), which show the same type of bullet. This fact adds credence to the vibrational node hypothesis. Evidently initial yaw is not a random result — it is related to specific gun and load characteristics and is initially quite consistent. However, this observation (if correct), would not suggest that long-range results would be consistent. Other variations (such as slight velocity and BC differences) would tend to work against long-range consistency; even identical yaws would, therefore, result in increased dispersion beyond point-blank range.

One final note, you might observe that the primary shock wave is not a straight line as it moves away from the bullet's point. Since the speed of sound in air is a constant, this might be confusing. However, note that the speed of sound in air is a constant only in air of constant temperature, pressure and humidity. Near the bullet's tip, air pressure and temperature increases in response to the bullet pushing this intervening gas out of its way. As the pressure in a gas increases, the speed of sound in that gas increases. Therefore, in this pressurized zone, the shock wave moves away from the bullet faster.

Since the bullet is also slowing, the angle of the shock wave is constantly changing — it forms a wider cone at lower velocity. Therefore, the wave will not define a straight line but will form a convex curved line. However, this effect is not visible at this small scale.

(In the big view, the primary and secondary shock waves are not parallel in these prints. This is because the reflective surface is not equally distant from the camera lens at all points.)

I found these photographs interesting and enlightening. I can also add that the bullet types which showed visible yaw did not produce acceptable accuracy for Norma's factory loadings. That fact seems less than surprising.

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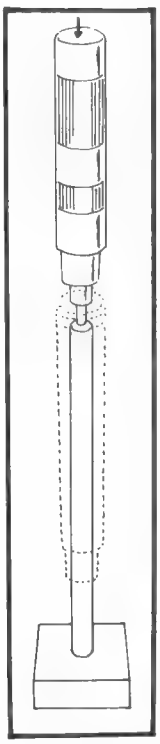

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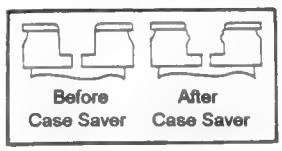

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A Bit (Three Bits, Actually) of Nostalgia

FROM ART CROWTHER
"THE OLD REBEL"

Dear Dave,

Photos No. 1 and 2 are not the absolute sharpest photos ever... but they'll have to do.

About 45 years ago, back in 1951, my wife (the first and only woman to win the Harvey Donaldson trophy at Johnstown.. a feat that she carried off in 1952) and I took off on a belated honeymoon. We had gotten married in 1949, and this was 1951. After I had gotten out of the Army in 1946, I bought a Jeep. In 1951 I quit my job, and so did my wife. We borrowed $2,000, ostensibly for "home improvements", and headed for Alaska.

I packed both bench guns that I had made up. One was a 22-250, and the other a 219 Donaldson Wasp.

Photo No. 2 shows my wife and I at Mile Marker "O", at the very start of the Alcan Highway, in Dawson Creek, British Columbia. A little bit of squinting at the signpost behind us shows that is 1, 523 miles to Fairbanks, Alaska from here. We carried our two rifles to Fairbanks, and then on to Anchorage, packed in a wooden box in our Jeep. My wife and I planned to shoot in a bench rest match on our way down the west coast to Mexico.

The match was to be held in Seattle, Washington. Keep in mind that, in 1951, benchrest matches were few and far between. We arrived bright and early in the morning of the appointed day... only to find that the match was postponed for a week! A notice to this effect was on the bulletin board outside the clubhouse. After I said a few nice words out loud, we headed to Mexico. I shall never forget that day. We had traveled 17,000 miles to a benchrest match... only to find it was

Photo #1

Photo #2

Photo #3

Photo #4

postponed! I took a photo of the clubhouse and (uncovered) firing line (photo No. 1 herewith), if only to prove that I had indeed been to the Seattle range.

Photo No. 3 is another old time photo. Bob Wallack is holding his daughter, and his wife Betty is on the left hand side of the photo, unfortunately more than a bit cut off by the unthinking photographer. The picture was taken in 1952, in Johnstown, New York.

I have been a subscriber to your magazine since it started in May 1956. I am enclosing a cover picture from your July 1956 issue. Note my address at the top of the cover - it's just my name, my town, and my state - no street address or zip code! In fact, I have a lot of copies of Shooters News, the predecessor of Precision Shooting. Just look at the price on the copy of the cover I sent - only 25 cents a copy or $3.00 per year!

Back in the beginning of Precision Shooting, the editor was P.H. Teachout, with Henry Butterfield as president. Irv Monkern as vice president, with William Cotter as treasurer and PH Teachout (again) as secretary. When it was Shooters News and before Precision Shooting, the editor was PH Teachout and assistant editor was Laurence Moore. Larry and I worked together at Aberdeen Proving Ground for many years in Small Arms. He has always been a great shot; even today he wins in the senior citizens matches.

I think it was 1947 or 1948 when I started subscribing to Shooters News - it's been 46 - 47 years ago. I could only locate this July 1956 copy, Volume 1, #3 of Precision Shooting, but I will continue to look to try to locate my first issue.

I shot benchrest with Cotter, Monkern, and Teachout at Johnstown, New York in the 50's, if I remember correctly. I still have one of the so-called "crying towels" from the Pine Tree Range in Johnstown, New York dated January 5, 1955. Some of the autographs include Wilbur Hauck, Ralph Pride, Mike Walker, Sam Clark, Clyde Hart, William Cotter, Al Hoyer, and myself. Attached is a list of the names I can still read from the towel. There are about 40 names in the towel (See photo No. 4) and I felt very honored to be on the range with the likes of John Unertl, Townsend Whelen, and G.R. Douglas.

Since then, a lot of them have left the range. Myself, I shall always remember the great times and the help they gave me.

(Editor: The "crying towels" are quite rare today. Your truly has one, which was previously owned by Harvey Donaldson. Obviously Mr. Crowther has one, and it's the more desirable autographed version. We are curious as to just how many other "crying towels" we can learn are still in existence today).

NAMES ON CRYING TOWEL

Bob Hart
Al Creighton
Harvey Donaldson
Charles R. Hart

Bill Kerr
W.J. Hauck
Ray Rhines
Ralph Pride

William E. Cotter
C.B. Southard & Jane
John Warren
Schuetzen

Sam Clark
Jim Perry
C.B. Brown
Clyde Hart

Olive Walker
Al Hoyer
George McMullen
Don Callar

Harry Cook
J. Hoyt
J. Rod Janson
M.C. Babcock

J.W. Baldwin
Art Crowther
Ray Biehler
Wasden

Bill Santay
George Morton
George Hooker
Mike Walker

Joe Judson
Harold Hayman

There are other names on the towel, but they are so faint that I cannot read them.

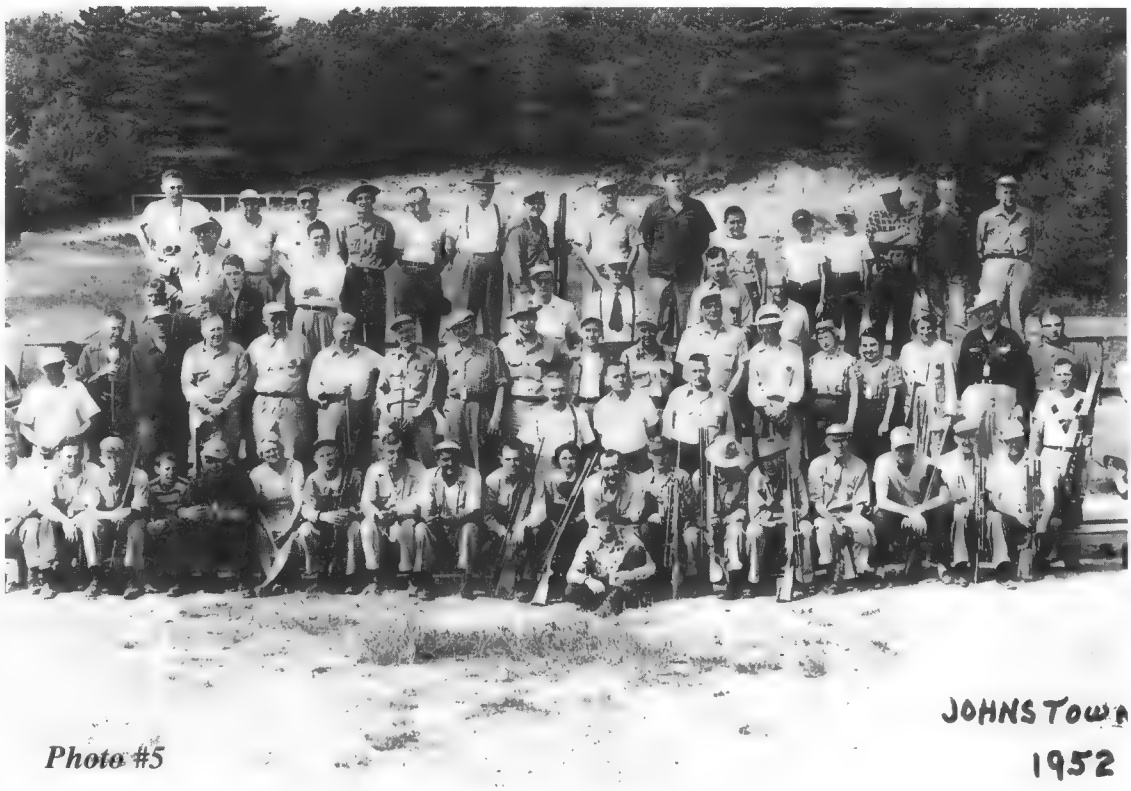
Ps: I would very much like to hear from any of my old shooting friends from "The good old days".

As for photo No. 5... it's a group photo, taken at the Pine Tree Rifle club in Johnstown, New York in 1952. I wish I could identify more of the shooters, but I'll plead the excuse of "44 years ago", and hope that you will accept that. Let's see... Mike Walker is on the extreme left of the top row, and Warren Page, complete with sunglasses is in the front of him. In that top row, R.K. Nelson (the sparkplug at the rival Dubois, Pennsylvania range) is seventh from the left, and Homer Culver is eight from the left. (Editor: I believe that the sixth from the

Continued on next page

A Bit of Nostalgia
Continued

left would be Virginia Bill Curtis, and the fellow on the other side of Homer Culver is Bob Wallack). Second row from bottom... fourth from left (hatless) is Sam Clark Jr. and sixth from left in Crawf Hollidge. The lady who is third from the right in this row is Olive Walker. Bottom row, tenth from left, with a rifle, is yours truly, Art Crowther, the old rebel. Next to me, also holding a rifle, is my wife, Darce Crowther. Next to her is Al Marciante with his two sons. Just behind me, wearing suspenders, is John Unertl. Front row, eighteenth from left, with crossed hands, is Ross Pitt.



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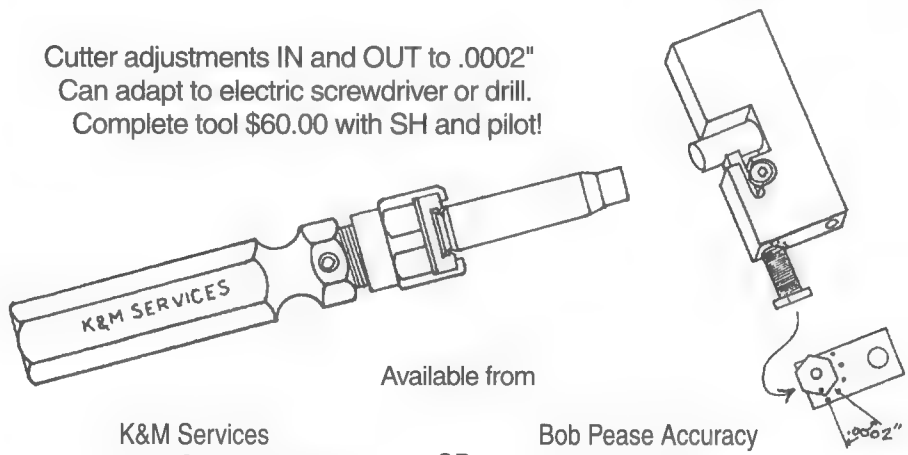

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BY JACK RUSH

Many of the decisions related to varmint shooting depend on the goals and objectives of the shooter. A chuck hunter with the single minded purpose of very long range shooting attempting to get that one shot hit will have different needs than the fellow who plans to fire 500 rounds a day and shoot at as many prairie dogs as possible. Each person who addresses the subject will have different ideas than another equally competent varmint hunter with different objectives.

My experience over the years has been primarily with medium to long range prairie dog shooting, with a good measure of western rock chuck shooting thrown in. My objective has been to stretch the limits of my equipment and shooting ability, without regard to the number of shots fired or animals taken. Most of my shooting has been done between four and seven hundred yards, but by no means limited to that spectrum of range. I use a wide variety of cartridges and rifles. One might liken it to fishing walleye with a two pound line. I like to work at the outer edge. No shot is ever wasted, I learn something either short or long term with every shot fired, and misses don't discourage me.

The alternatives we will look at here are:

1. The rifle
2. The shooting platform
3. The optics
4. The ammunition

First, the rifle must be in the portable weight range. Anything over about 12 pounds can become a burden under varmint shooting conditions. Since I do most of my varmint shooting over a portable bench, my rifles tend to run at or slightly above that weight. One of my varmint shooting companions uses a seventeen pound 22/250, and I must say I admire it. He has to alternate hands when he carries the case very far to the bench to avoid one leg becoming shorter than the other.

It is possible to be very competitive with rifles in the ten to thirteen pound weight range, and so the accuracy potential of a varmint rifle is not greatly disadvantaged. As the saying goes, there is no such thing as too thin or too rich. There is also no such thing as a rifle that is too accurate. There may, however, be such a thing as a rifle that is too heavy or too expensive to pay dividends in the varmint field.

The choice of a rifle is a highly individual matter. I would choose a moderately heavy barreled (#6) tube of from 22 to 28 inches, depending on caliber and use. I prefer custom rifles on Remington actions in laminated or synthetic stocks. The stock should have a flat forend not less than 2 inches wide.

Caliber selection is part of choosing the rifle. For a lot of shooting at ranges never exceeding five hundred yards one of the .222-.223 family is an excellent choice. For ranges in the four to seven hundred yard category, I would choose something in the 250 Savage, .243, 22/250 volume range. If you plan to extend your shooting to occasional shots beyond this to a thousand yards, you may need improved versions of these cartridges, or something a bit larger. If you plan to restrict your shooting to these longer ranges and go for frequent one shot kills you may wish to chose a larger bore of perhaps 30 caliber, with case volume in the 300 Winchester Magnum category.

There are many factory varmint rifles on the market that will shoot satisfactorily with a bit of attention to bedding and trigger. These come in the above mentioned range of cartridges.

I would currently consider the Savage BVSS-s to be the least risky choice. I have seen and shot several and have not seen one poor shooter among them. Whether you go custom or commercial, you always risk the possibility of a poor shooter.

For the type of varmint shooting that I enjoy, that is medium long range, the most stable shooting platform possible is required. I find that shooting from a pick-up hood is quite inadequate, and bipods from prone severely restrict visibility and stability for long range. I favor a portable bench, with maximum stability within the limits of portability. Portable benches are a far cry from the benches of a formal range.

I carry two benches on extended prairie dog hunting trips. One has 3 inch diameter screw on legs and is quite heavy. I set this up on large dog towns that may provide a full day or more of shooting. I also carry a lighter folding leg table for situations requiring a bit more mobility. It has box joint legs of one inch square tubing. Good construction minimizes wobble. Extra features such as attached seat or rotation can add weight but may

Continued on next page

Varmint Shooting Accuracy
Continued

also introduce less stability.

I choose a small adjustable front rest, similar in design to those used in formal bench shooting. A grooved rear bag completes the shooting platform.

Shooting from a bench is not the sure thing it is so often characterized to be. Try a variety of ways of holding the rifle. Generally, shooting from a portable bench under field conditions requires a fairly snug hold. Try a variety of holds, and when you get good results, stick with it. Consistency, as in any sport, is fundamental to success.

Scope choice is important. For varmint shooting, good magnification and optical quality are paramount considerations, but the variable ranges involved, along with field conditions, dictate what is practical. Fixed power scopes of high magnification, like 32 power, render the rifle useless under high mirage or for picking out closer targets to coordinate your shooting with your spotter. Adjusting to various ranges quickly is a primary consideration in choosing a varmint scope. I recommend something in the twelve to twenty-four power range, it should be a variable to adjust for tolerable viewing and field of view, and it should have easy to use elevation adjustment. That it must have an adjustable objective that is quick and easy to use is obvious. I consider the Leupold 6.5X20 the standard by which varmint scopes are measured, though there are several other viable choices. Don't skimp on quality glass.

Ammunition preparation will vary according to application and volume of rounds required. For the very long range shooter nothing will do but the finest, produced by the best practices described in the pages of PRECISION SHOOTING. For the greater number of rounds required for a lot of shooting at more modest ranges, a few short cuts may be allowed.

Here are the steps I have found useful in getting the accuracy I need: Choose good brass. Throw out off center flash holes. Buy brass in volume and try to use lots of brass that stay within about five grains variation in weight. Weighing one in ten cases will soon tell the story on a volume lot of brass. If the brass shows unacceptable weight variations, more careful weighing and sorting may be required.

Either neck resize to the shoulder or full length resize.

Carefully trim.

Turn necks so that about 50 to 75 % of the brass surface is removed. Going further may result in cases that will not hold the bullet securely due to your die dimensions. After load development try the same load with unturned brass. If there is no significant difference, don't bother with neck turning. Notice I said IF.

True up primer pockets so that the primer seats on a flat surface for consistent ignition.

Deburr the inside of the flash hole.

After firing, neck size only, until the brass becomes stiff to chamber.

Try two or three primers with your best load. They seldom make much difference and you may find that a more expensive match primer is neither needed nor desirable in all cases.

Seat primers carefully and consistently. Never touch primers with your fingers. Use a lab tweezers. Finger oil alters primer chemistry in a relatively short time.

Load charges from a good quality measure. Unless you are using coarse grained powder, dribbling to the last kernel is usually not productive.

Bullet seating depth is the most critical factor. Start by touching the lands and back off .005 at a time. A good seating depth tool and a micrometer seating die are great assets at this stage.

These procedures will result in accurate ammunition. If you cannot achieve satisfactory results, the chances are that you cannot improve significantly by further refinements of loading technique. Look for problems in bedding, scope, mounts or perhaps a poor barrel. Are you cleaning regularly?

As to choice of bullets, quality is very important. However, good commercial bullets will suffice for most shooting. High quality custom bullets will improve the performance of a really good barrel. They are no cure for a poor barrel.

Very long and heavy bullets are best for very long shots. They require tight twists. Bullets of medium weight for the caliber are the most versatile, and best for most shooting. Avoid excessively tight twists if you plan to use what I call "normal" bullet weights. Very light bullets (like 40 grain in high velocity 22 caliber) are a poor choice. They are spectacular at close range but shed velocity quickly and deflect badly in the wind. They are great for extending effective expansion in small rifles like the Hornet and Bee.

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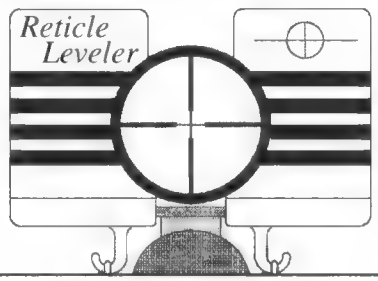

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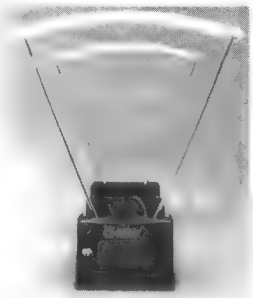

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PETE'S FIX

OR HOW TO PREVENT AR-15 OPEN BOLT INDICATOR DISASTER

BY
RICHARD L.
BERGLUND

Pete Oregaugh kept me laughing as he described the antics of a M-16 competitor and his armorer during a match at Quantico as they struggled to remove a jammed open bolt indicator from the rifle.

The process took a full five minutes, four hands, a screw driver, a Gerber tool, a gallon of sweat, profanity that caused the Marines to blush, and exceptional acrobatic skill. What a way to ruin the concentration required in this sport!

Pete said that the jam was a serious problem and admitted that he also had experienced this horror. The top of the indicator will jam between the locking lugs of the bolt carrier and the receiver, creating a problem of major proportions. You literally have to tear the open bolt indicator apart to free the jam.

Pete was kind enough to share his fix with me. It was simple and effective. Tap a fired .45 Auto shell case over the head of the indicator and trim tothe proper length for the chamber. You must make a 3/8" slit between the indicator's shaft and the top of the flag toallow the .45 auto case to be tapped onto the shaft.

Problem solved, because the diameter of the head of the open bolt indicator has been increased and will no longer fit between the bolt carrier and the receiver. One final suggestion is to release the bolt carrier gently by pulling back on the charging handle and slowly moving to forward to rest squarely on the open bolt indicator.

THE Real 6MM/HLS Steps Forward

BY ED LANDERS & RALPH SAYLOR

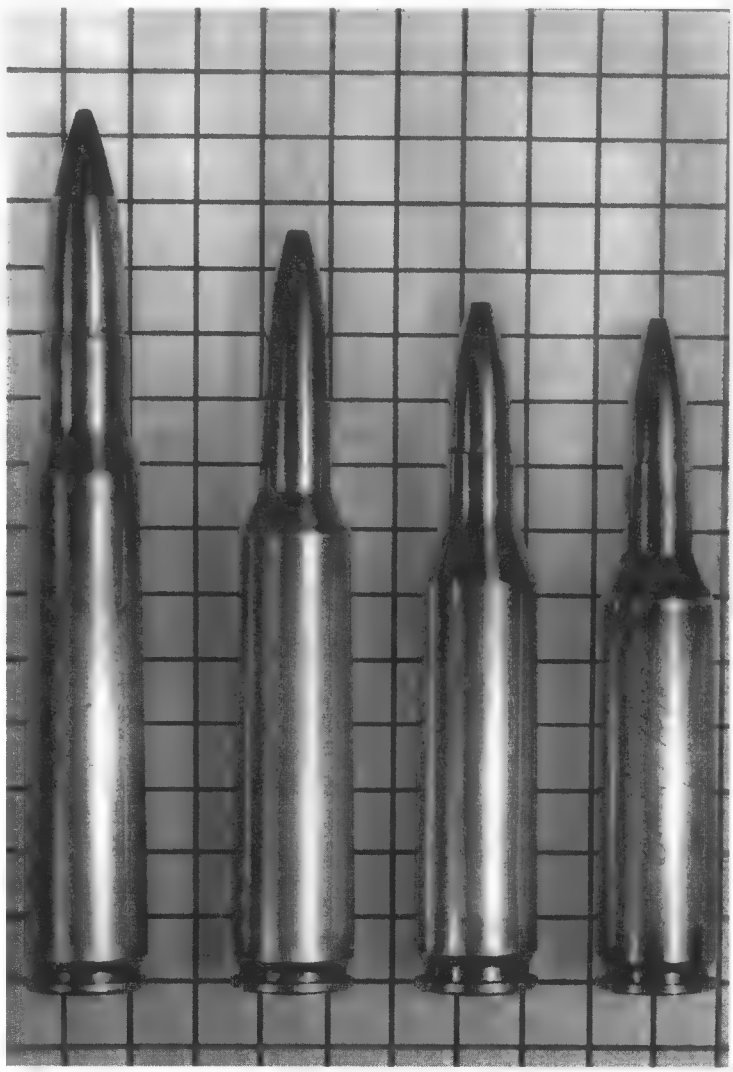
Mike Winkler's story of his trails and tribulations titled "The 6MM/HLS" in the May '97 issue of ***PS*** opened old wounds in Ed Landers and Ralph Saylor, the two remaining of the original Hammack, Landers, and Saylor. Olin Hammack left the range a few years ago and is still sorely missed.

The original 6MM/HLS had its birth nearly 40 years ago when Ed Landers and Ralph Saylor were searching for a 6MM cartridge without the 'only one load shoots' affliction of the 243 Winchester, 244 Remington, and the 6MM Walker International. We figured that the case should be a mite larger than the Walker International and with a neck-shoulder like the 244 Remington.

The first and only version of our 6MM/HLS we ever made is simply the 244/6MM Remington case shortened 0.225". The chamber is cut with a standard 244/6MM Remington reamer run in short so as to head space on a 22/250 go-gage. Don't worry about the shoulder angle difference since it merely results in the reamer going a few thousandths deeper to accept the head space gage. The overall case length maximum is 2.008" and the maximum chamber length from bolt face to end of neck is 2.015".

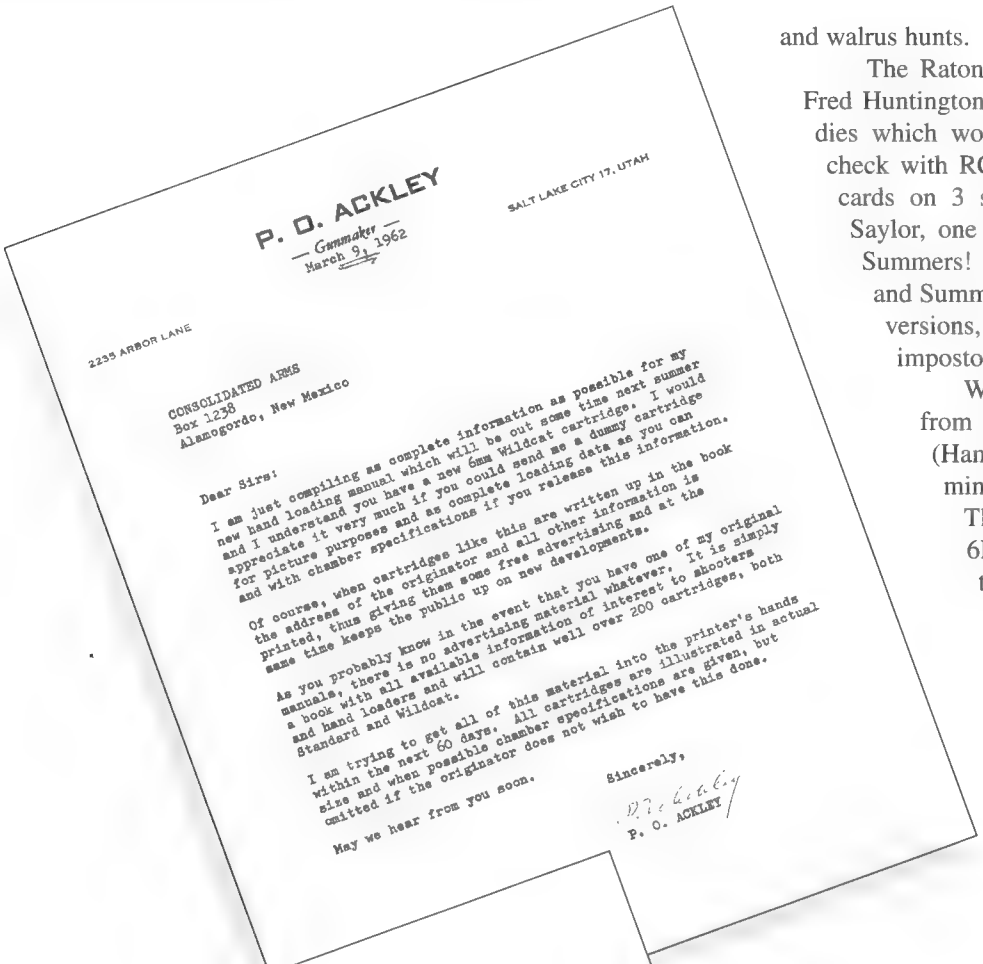
The enclosed photograph of 30/06, 244/6MM Remington., 243 Winchester, and the 6MM/HLS was taken against a 1/4" grid and is approximately 2 times actual size. Note the 6MM/HLS is just over the 2" line in length.

The enclosed correspondence from P.O. Ackley shows his solication for data on the cartridge and our prompt response with data (same as paragraph 3 of this piece) and a dummy cartridge. We fully expected to receive a draft of his write up for our approval before his going to press with his *Handbook for Shooters* and *Reloaders, Vol. I.* Apparently, P.O. was overcome by his 60 day printers deadline. Had we been given the opportunity to correct his write up, the kind of travail experienced by Mike Winkler, and possibly many other shooter would have been avoided. We never could understand how anyone looking at a 6MM/HLS case and a 250/3000 case could say the lengths are the same; the 6MM/HLS being nearly 0.1" longer.



30/06 244 REM 243 WIN 6MM HLS

The 6MM/HLS exceeded all our expectations. Ralph Saylor won the "First National Sporter Rifle Championship" in San Angelo, Texas, August 1960; the first bench rest match he ever shot and Ed Landers wasn't far behind the aggregate. The shooters at San Angelo were so enthusiastic about our rifles, the cartridge, and a little pocket reloading tool we called "The Handy Dandy" (covered in the January 1962 issue of PS) that we decided to go into business. We had fun for three years and then closed our doors. We sold more Handy Dandys chambered for 22 Hornet to Eskimos and Indians in the far north than anything else. They used the Hornet for seal



P. O. ACKLEY
—Gunmaker—
March 9, 1962

2235 ARBOR LANE

SALT LAKE CITY 17, UTAH

CONSOLIDATED ARMS
Box 1238
Alamogordo, New Mexico

Dear Sirs:

I am just compiling as complete information as possible for my new hand loading manual which will be out some time next summer and I understand you have a new 6mm Wildcat cartridge. I would appreciate it very much if you could send me a dummy cartridge for picture purposes and as complete loading data as you can and with chamber specifications if you release this information.

Of course, when cartridges like this are written up in the book the address of the originator and all other information is printed, thus giving them some free advertising and at the same time keeps the public up on new developments.

As you probably know in the event that you have one of my original manuals, there is no advertising material whatever. It is simply a book with all available information of interest to shooters and hand loaders and will contain well over 200 cartridges, both Standard and Wildcat.

I am trying to get all of this material into the printer's hands within the next 60 days. All cartridges are illustrated in actual size and when possible chamber specifications are given, but omitted if the originator does not wish to have this done.

May we hear from you soon.

Sincerely,

P. O. ACKLEY

TELEPHONE CR 7-1740

P. O. ACKLEY
—Gunmaker—
March 15, 1962

2230 ARBOR LANE

SALT LAKE CITY 17, UTAH

Mr. Ralph Saylor
CONSOLIDATED ARMSMORE
P. O. Box 1238 - 209 - 13th St.
Alamogordo, NEW MEXICO

Dear Mr. Saylor:

I received your dummy cartridge and the information to go with it and I will give the cartridge as much space as I can in the book. This one is about the right size for 6mm and I have been hammering on this point for many years and of course we will bring this out in the description of the cartridge.

It would appear that the Remington factory has a similar idea in their 6mm International and the .222 Magnum necked up to 6mm.

If you know of any other Wildcat cartridges, whether they have much merit or not, I will appreciate having the names and addresses of the originators so that I can get the information to go in the book. Naturally, whether the cartridges are good or bad, I still want to get as many as possible into the book, even though our descriptions cannot always be complimentary.

In the last two days I have received orders for two new monstrosities, if that will describe them. One is the .308 Norma necked down to 6.5 with the top of the shoulder. This of course makes a good enough belt to the top of the shoulder, but the area of the shoulder is so bore and case capacity ratio, but the body is about 1/8" longer or about great that a great deal of bolt thrust is bound to develop. Then the other one is a 6mm with about 50 grain capacity. It is not quite so exaggerated in that the body is about 1/8" longer or about 1¼ inches from the belt to the shoulder. It is bound to give the same difficulties with bolt thrust, but the idea of this one is not so bad, at least from the commercial standpoint because the original tor feels that those who want a magnum in short actions designed for the .243 and similar length cartridges could have their rifles re-chambered for this hort magnum and then later bore it up to the next size and then on until it gets up to .35 or larger.

As you indicated in your note, a cartridge case must have some length and for 6mm I would think that you would have about as good a combination as possible.

and walrus hunts.

The Raton Gun Shop made all our reamers and Fred Huntington of RCBS made all our cases forming dies which worked perfectly. Incidentally, a recent check with RCBS reveals that they have production cards on 3 so-called 6MM/ Harris, Landers, and Saylor, one called the 6MM/Harris, Landers, and Summers! Ed swears he never worked with Harris and Summers. So with the Redding, and Winkler versions, all slightly different, there are at least 5 impostors out there.

When you order your 6MM/ HLS die sets from RCBS, be sure to specify 6MM/HLS (Hammack, Landers, & Saylor) with 2.010" minimum chamber length.

The most outstanding feature of the 6MM/HLS case is its flexibility in 12" twist barrels. We shot many 5 shot groups for fun and demonstration back then, using 3 different powders/ charges and 2 different bullet weights (60 gr. and 75 gr. Sierra) into 0.7" or less at 100 yards-- with 8 power scopes!

The original 20 cases made for the championship rifle were reloaded over 100 times before they were retired to dummy round status. Of course they were neck/shoulder annealed after forming and neck turning and at the 25, 50, 75, and 100 round points.

We sincerely apologize to all the shooters out there who may be shooting orphans because we never took the time to write this 35 years ago.

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FRED ADOLF

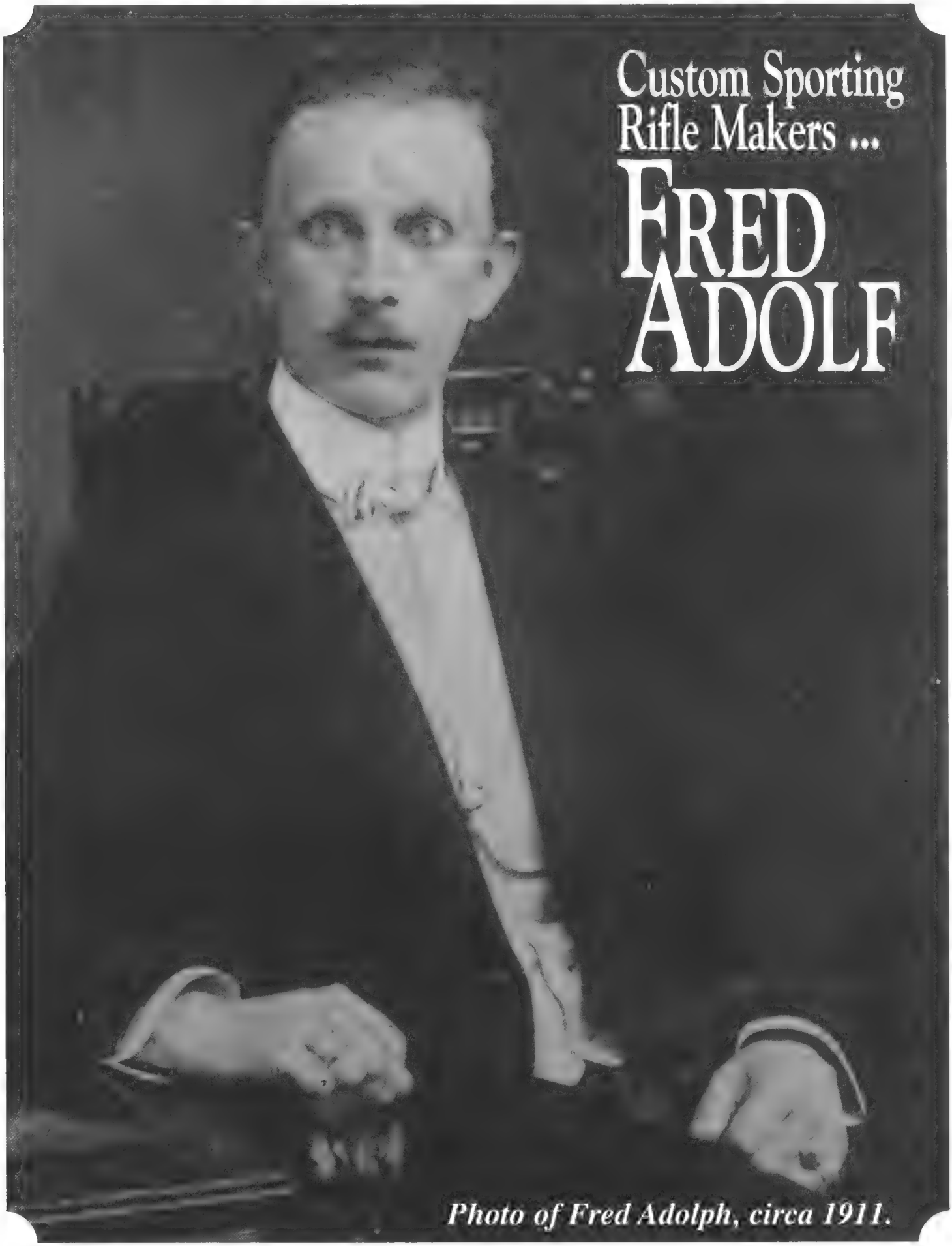

Photo of Fred Adolph, circa 1911.

BY JIM FORAL

For the most part, the custom sporting rifle makers of the early Twentieth Century were content to quietly occupy their hours at the bench planing and shaping stock blanks, inletting actions, and working their magic on the military 1903 Springfield. In the main, this was a practical and skillful, yet unassuming lot that received no terrific measure of attention, and shunned undue public notice.

An exception to his humble group of contemporaries was an individual who actively sought the limelight, and had a flair for getting this accomplished.

Fred Adolph, a foreign born talent, was perhaps the most colorful and controversial U.S. gunmaker to ever practice the trade.

Adolph specialized in supplying American men of means with quality ultra high grade guns built in the European tradition. He gained exposure and fame for the diverse array of elaborate combination guns he built and featured in his catalogs and advertisements. There were drillings of all descriptions, three barrel and even four barrel break open guns with rifled and smoothbore barrels in every imaginable configuration. One gun handling every requirement in the gamefield was a new concept to American shooters until Mr. Adolph arrived on the scene. Also included in his line of offerings were double rifles with barrels either over/under or side-by-side. One shotgun barrel in this twin tube setup was a popular arrangement.

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He made single and double barreled bird and trap scatterguns. Simple sporting rifles, and the odd Schuetzen rifle, were built on German and Austrian falling block single shot actions. Magazine rifles based on commercial '98 Mauser, U.S. Krag and Springfield receivers could be bought, too. Ornamentation was an Adolph trademark. Although degree varied from piece to piece, his better guns were, in general,highly embellished. Metal work was generally engraved. Some was done modestly and tastefully, others were garish eye-poppers. Fancy precious metal game scene inlays were rather common, if the guns pictured in Adolph's best-foot-forward catalog cuts are any indicator. A monogram, incorporating the initials of the new gun's commissioner were executed in some conspicuous location on a high percentage of these Adolph best quality firearms.

Though the preference and practice clashed somewhat with conventional American tastes, stocks and forearms were typically covered with ornate carving, rather than the traditional checkering. Oak leaves, acorns, and vines adorned many of the stocks leaving Adolph's shop. The degree of the ornamentation depended upon the pocketbook of the purchaser. Adolph's brand of checkering (they called it "checking" in those days) followed the Old World thought, and took the form of essentially flat-topped, rather than pointed diamonds. Most of it was rather fine, 22-24 lines per inch, tastefully done, and attractive, to my eyes at least. Checkering panels were usually flanked and offset by cut bows, arcs, curlicues, or carving of some sort. Photographs of Fred's later checkering proves that he was able to adapt to cutting the nice pointed diamonds American gun cranks were familiar with.

Adolph's guns were priced out of reach of the common working man. A plain unadorned single shot rifle could cost forty to fifty dollars, while a basic three barrel gun would have set any rich man back $150 for starters. It went up from there. Some of Adolph's creations dangled price tags of 900-1,500 dollars. Bear in mind that the very ordinary 1894 Winchester lever action, in comparison, could be had, new in the box, for fifteen bucks. At thirty-five cents, the average pauper had to work almost half a day just to send off for one of Adolph's high priced catalogs.

On January 29, 1876, Fred Adolph was born into an old German family with a long and rich military background. As a youth, he demonstrated a passion for guns, and at a young age he was apprenticed to a gunmaker near his home in Glantz, Germany. After this grueling five year program, young man Fred honed his skills in Strassburg, where he worked on high grade rifles and shotguns. He later found work at the Swiss concern of Casimer Weber in Zurich. After a time, Adolph flitted through Europe, settling long enough in various locations in Austria, Germany, and Prussia to gain valuable experience and contacts. A three year tour of duty, as an infantryman, with the German Army interupted his gunmaking career.

In June of 1908, he immigrated to a place he liked to call "the land of unlimited possibilities". Having completed the Ellis Island ritual, he and his pregnant bride settled into a dwelling at 10 Ariel Park in Rochester, New York, where he began to minister to the moneyed gun cranks of this country on a custom, made to order basis. In 1911, he moved his family and base of operations to Genoa, New York, a little village of 2,000 souls.

Mr. Adolph had both creative and inventive flairs. Overseas, he was an accomplished and recognized painter, and had a talent for writing music. He was a more than passable poet, his work was published in several European countries. In his later years in America, he printed a book of German poems and love songs he'd written.

Across Europe, he was granted a number of patents for gun related accessories he'd developed. He contributed several technical articles on the subjects of guns, ammunition, and ballistics, and succeeded getting them published in various German sporting and trade journals. These communication skills would later prove to be helpful in furthering his exposure and reputation in the United States.

Faced with the difficult obstacle of an unknown, newly immigrated gunmaker getting noticed on a national scale, and subsequently establishing a reputation and following, Adolph devised a crafty plan of subtle self-promotion. His method of becoming conspicuous was

Continued on next page

Custom Sporting Rifle Makers - Fred Adolph

Continued

simple, direct, and proven. He made the move of contacting prominent writers and personalities possessing the capability and likelihood of publicly exerting their influence by endorsing his goods. He then presented to them a gun he'd made, or had made, especially for the individual. The listing of recipients read like a Who's Who of the important figures on the sporting and journalistic scene between 1911 and 1913.

Chas. Askins Sr., this country's leading authority on the subject of shotguns at the time, received a deluxe game scene engraved, gold inlaid three barreled gun. This was a twenty bore side by side with a .25 Krag rifle barrel underneath. The signature inlaid gold and silver initials of the owner are found on the cartridge trap cover. If Askins ordered the gun from Adolph, he failed to mention it. The drilling looked good enough to be featured in Adolph's catalog, and merited a full page *OUTER'S BOOK* advertisement devoted to it. Askins described his Adolph built in flowery terms in 1913.

A few years ago, a certain octogenarian, someone who remembered the gun well, confided to me that the rifle barrel "couldn't hit a barn from the inside", and it didn't hang around the Askins' place very long.

To possess and fondle, Bob Kane received a Webber-Adolph single shot target pistol from Adolph "as a special compliment to me and without my knowledge". Kane was a prominent figure. He edited the Arms and Ammunition department for *OUTER'S BOOK*, an extraordinarily popular periodical at the time. It is important to remember that nobody with any sense missed Kane's stuff, but the advertising section of the magazine was often bypassed. Adolph gave the Kane pistol the full treatment, including the gold letters RAK intertwined on the grip. In exchange, Mr. Kane penned a three page description, sparing no superlatives, in *OUTERS* for November of 1912. He wrote: "This beautiful specimen of the gunmakers art was made and stocked for the writer by Fred Adolph of Genoa, N.Y." He was obliged to add "Mr. Adolph is prepared to duplicate this ideal target pistol for anyone who will favor him with their order, making such variations in model of stock or decoration as they may desire".

E.C. Crossman, a period gunwriter of colossal influence, was the recipient of an ultra fancy single barrel trap gun. This is unquestionably one of the very few half octagon barreled shotguns extant with forend and pistol grip terminating in elaborately carved lion heads. The underside of the triggerguard carries the initials E.C.C. in gold. On the top of the barrel, the name of the gunmaker was inlaid in a different shade of this precious metal. It is not recorded if this engraved shotgun was exchanged for the kind words Crossman wrote about it in his *FIELD AND STREAM* column for September, 1912.

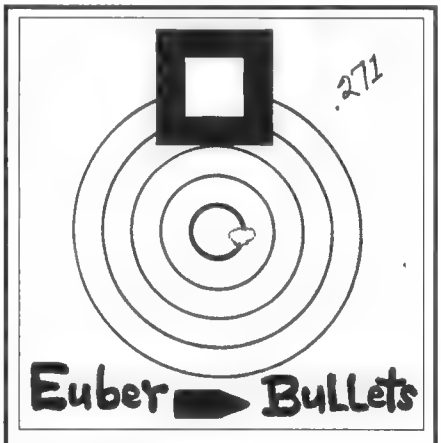
Lt. Townsend Whelen, who, in 1910 described Adolph as "the best workman I know" was a regular customer and had a variety of Adolph made arms. First among them, most likely, was a deluxe restocking job on one of Whelen's pet Winchester lever action rifles. Another project, completed in 1909, was a Lyman sighted Krag rifle remodeled with an Adolph cheekpiece stock to the Lieutenant's design and specifications. In 1912, Whelen was presented with a presumably unsolicited over/under rifle. He was moved to admit that his new 20 gauge over .30-30 WCF was a "peach of a gun".

While he was still conducting business from his Rochester, N.Y. location, Adolph undertook another project for the young officer. The fact that he was engaged in fabricating a sporting Springfield for popular and widely read Lt. Whelen was a point worthy of broadcasting. A small display ad in the February, 1911 issue of *OUTERS* made profitable use of Whelen's commission of a sporterized 1903.

Whelen put an Adolph stocked and remodeled .30 Adolph Express '98 Mauser showpiece through its paces, and wrote up a report in the July,1913 number of *OUTERS*. Whelen mounted his own Winchester A-5 scope on the rifle. Anyone reading this clinical account would gather the impression that this particular rifle was on loan for testing, but Whelen referred to this gun as "mine".

Perhaps the most luxurious Adolph firearm made for a notable was the 20 gauge over .25-35 WCF combination gun bestowed upon Teddy Roosevelt in 1912. Adolph personally hand delivered the arm to Sagamore Hill and presented it to the delighted but somewhat surprised ex-President. A reporter for for the local Tribune, co-incidentally in attendance with pen and paper in hand, wrote that the gun was "without the slightest doubt the most beautiful gun ever built in America, a work of art in the highest sense". The metal work of the break open weapon was heavily and extensively engraved and gold inlaid with Indian figures. The Circassian stock was ornamented with intricate relief carvings on pistol grip and forearm.

Every literate gun crank alive in 1912 knew who Chas. Newton was. Newton and Adolph had a close working relationship that was symbiotic in effect. I like to think that Mr. Newton was above promoting Adolph for a free gun, and he probably was. One of Newton's roles in their alliance was broadcasting Adolph's part in their collaborative experimental cartridge development, and stressing Adolph's willingness to accommodate that era's gun enthusiast. Adolph would do, or have done, special work the arms



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factories might consider crack-brained or eccentric. in any event, Newton had an Adolph drilling or two, and he spoke highly of the guns and the ability of the gunmaker.

Adolph's scheme to attract attention to himself worked-very well. He may have had to give away a few guns in the exposure process, but he quickly achieved a notoriety that would have taken years to acquire by more conventional methods. Fred Adolph was one of the earliest to practice the art of sporterizing the Springfield rifle on a commercial basis. Adolph's first magazine ads that I've noticed announcing his services as a general gunmaker appeared in *FIELD AND STREAM's* 1909 issues. The first advertisement for Springfield sporting rifles was in *OUTERS BOOK* for February, 1911, while he was still in Rochester. Most likely, Adolph and Wundhammer, his cross country contemporary, both got started restocking and remodeling the U.S. service rifle about the same time, in 1910. Incidentally, period accounts seemed to attribute the fad of converting a U.S. military rifle to sporting form to having originated, or at least publicized, with Paul Jenkins, a popular writer of the day. Jenkins had a Krag remodeled by an unknown someone back in 1908 or 1909. The possibility exists, however, that Adolph beat him to it. Lt. Townsend Whelen wrote in 1914 that his own Adolph-Krag conversion had been put together "several years ago". Adolph put together Whelen's Krag sporter in 1909.

The most photographed of Adolph's guns is the Springfield sporter he made for F.W. King in 1911. Whelen's *THE AMERICAN RIFLE*, Sawyer's *OUR RIFLES*, various Adolph catalogs, advertisements, circulars, and a couple magazine articles written around 1912 are well illustrated with this rifle. Evidently, Adolph considered this gun to be a respectable example of what he could do with the common Springfield.

Fredrick W. King was a Cleveland oculist and manufacturer whose specialty was optical instruments for participants in the shooting sports. After 1900, nearly every trapshooter that ever swung on a clay bird did so while wearing a pair of King shooting glasses. King also imported a line of binoculars, telescopes, and other related optics. Together, King and Adolph co-developed a riflescope in 1911, the first domestic hunting scope of its type. The King-Adolph scope was ahead of its time. By and large, the public wasn't prepared for such an innovation. Although it wasn't successful in the marketplace, the scope was widely and enthusiastically endorsed, even by those who had to pay the full sixty dollar price for one. Adolph built a rifle for his associate. It began as a standard issue 1903 with the arsenal barrel.

The stock is a breathtaking piece of multi-hued Circassian walnut, well fitted and finished. A Lyman #48 Long-slide, just beginning to fall into favor back then, is the rear sight. The customary gold and silver monogram, the intertwined initials F.W.K., is located on the bottom of the triggerguard. Unlike most of Adolph's guns, he didn't place his mark on this one.

Regrettably, the King-Adolph scope has been separated from the rifle, and it is probably laying around a pawnshop somewhere. If any of you run into it, I'd appreciate being notified.

Fred Adolph's catalog, the second edition of *MODERN GUNS* distributed in 1915, carried his fee schedule for converting the 1903 to a sporting style rifle. A basic handmade stock of imported walnut, built to fit the buyer, was twenty dollars. A cheekpiece could be had for the usurious charge of two dollars extra. If one wanted the special trap steel buttplate, he needed to allow another three bucks. Send in eight dollars more yet, and Adolph would perform the necessary metal work, including removal of the rear sight base, and polishing and bluing the barrel. Another eight dollars bought a Lyman #48, attached to the receiver.

If one couldn't live without his new rifle being chambered for the .30 Adolph Express, the wonder of the day, one would want to save up another ten dollars to add to the ever escalating total. Prices for engraving, fancy checkering, or carving were quoted upon application.

In the years before the Great War, gun nuts with particular demands, quirky ideas, or requiring custom work of some sort, had a deuce of a time finding someone to meet their needs. For the most part, gun factories were unwilling to perform special work on anything other than their own goods. Even then, there were clearly drawn restrictions. Adolph was not bounded by any particular limits. One individual, as an example, wanted a Mauser modified so that the rifle fired by pressing a tang-mounted button. Adolph was able to provide.

The up-to-date sorts with the urge to sample the new-fangled high velocity rifle cartridges, the latest trend in the shooting world, Adolph's workbench was one of the very few sources for rifles to shoot them.

Independently, our man from Genoa was one of the original wildcatters. Allied as he was with Chas. Newton, the pair was responsible for some interesting cartridge developments. Fred necked down the 11.2mm Schuler case to .30 caliber, and christened it the .30 Adolph Express. Within a year or so, this cartridge evolved into the .30 Newton, the rimless, beltless forerunner of uncountable .30 caliber magnums. The Schuler case served as a foundation for unsuccessful high speed experiments in .25 and .28 calibers. The parent case proved to be more practical when necked up to .33 and .35 caliber. Rimmed cases worked better in Adolph's break open combination guns and double rifles. Fred devised .25 caliber cartridges based upon the rimmed .303 Savage and .30-40 Krag shells. Also

Continued on next page

Fred Adolph Sporting Springfield built for F.W. King, 1911.

Custom Sporting Rifle Makers - Fred Adolph

Continued

Close-up of the left side.

Springfield '06 owned by F. W. King, remodeled by Fred Adolph and Scope mounted by him also

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The F. W. KING OPTICAL CO., Cleveland, O.

Magazine ad from June 1912 OUTERS BOOK, featuring the above rifle.

The monogram most of Adolph's guns carried. F.W.K. in gold and silver.

The cartridge at extreme left is a .30 Adolph Express. The two cartridges to the right are unfortunately not identified. Photos reprinted with permission of the The Gun Report magazine.

along these lines were the .30 Newton Express, a .30 caliber using the extremely long .40-90 Sharps Straight case, which, in terms of capacity, duplicated the .30 Adolph Express' velocity of 3,200 fps with a 150 grain bullet.

The .28-30 shell, shortened and necked to .22 caliber was developed to fit into a special Adolph made single shot long range pistol. Seventeen grains of Lightning powder blew a 70 grain .22 Savage Hi-Power bullet out of the muzzle at 2,000fps. Not bad for 1911.

Mr Adolph was a writer of enviable skill. Besides doing the flattering copy for his own catalogs, he contributed a limited number of especially good items to his era's sporting press, entertaining and educating readers with his captivating style. These were published in *OUTERS, OUTDOOR LIFE*, and *ARMS AND THE MAN* during the years 1911-1916. Some of his material was of a humorous sort, much more of it was of a practical and informative nature. On the technical side, he published studies and opinions on the topics of comparative rifle strengths, and results of chronograph tests of his experimental cartridges and those of others.

Hopeful of military adoption, Adolph developed a unique semi-automatic assault type infantryman's rifle. It was a compact nine and a half pound arm that resembled a pregnant Garand in profile. Presumably gas operated, the weapon utilized many of the component parts of the Springfield rifle. A series of cartridges was worked up in calibers .25-40. Most were based on a severely shortened 11.2mm Schuler case. 150 grain bullets from the .30 caliber version zipped across the chronograph of an unspecified powder company at 3,060 fps..

By 1915. Adolph's status as the "greatest gunmaker in the U.S., if not the world" was being questioned. Allegations that he couldn't have built all the guns he'd put his name on were emerging. The Roosevelt gun had taken the better part of a year to complete, everyone was lead to believe, but a steady supply of other high grade time consumers were shipped out of Genoa during the same period.

Almost certainly, Adolph did not build all these guns by himself, even though this is what was represented. Some familiar with his operations maintain that he built no guns at all, but farmed out the handwork to the artisans in Bavaria, Austria, and Germany he'd had the fore-

Continued on next page

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Custom Sporting Rifle Makers - Fred Adolph

Continued

sight to approach before boarding a steamer to America.

In 1915, a potential customer waltzed into Adolph's shop unannounced and found the gunmaker seated at a bench in a 15 by 20 foot workshop equipped with very few tools, assembling guns. It didn't take a mental giant to deduce what was going on, and the disgusted client took his business somewhere else. Another rumor, said to have originated with Adolph personally, was that he had a staff of eight highly trained men working for him. This may have been true, but the prevailing opinion was that these employees lived in various locations across the Pond.

There can be no doubt that Adolph had the expertise and the ability to turn out all the guns pictured in his catalogs. Most likely, he did a portion of the work himself, but not all of it. He just chose to conduct his business on a greater scale that the one man operation he'd inferred his to be. This practice is hardly a new thought. Ford Motor Company employees mass produced the Model T, but it was Henry Ford that got his name plastered all over the machine, and he alone received all the glory and all the credit. This technique is not quite acceptable in a gunmaker's case, we would all agree. In any event, even though the firearms manufacturer may have misrepresented to some degree, the customer got precisely what he bargained and paid for.

Further damaging Adolph's standing in the gun crank's community was a battery of complaints charged against him. Enough slippery dealings involving Adolph were brought to the attention of the Editors of OUTERS and OUTDOOR LIFE, that they were compelled to publish notices for the public's protection. One such detailed an accusation about Adolph receiving a customer's Springfield barreled action to restock. Fred failed to do the work or return the hefty deposit. The client's letters to Adolph demanding satisfaction were never answered. Magazine readers were made aware of the problem. There were two other complaints of a similar nature that I have seen.

Evidently, Adolph had somehow managed to step too heavily on some editorial toes at the Denver offices of *OUTDOOR LIFE*, which resulted in, as he wrote in a circa 1919 circular, the staff making unjustifiable "repeated attacks" upon his character. Reacting to *OUTDOOR LIFE'S* total disregard for "fair play", Fred expressed his intent to explain and defend his actions and motives in a pamphlet titled "*Hitting Back*". A quarter sent to Genoa would buy a copy of this apologia. Since the 36 page pamphlet also contained fifty cuts of fine handmade guns he'd marketed the previous three years, this timely venture appears to have been more of Adolph's sly self-promotion.

Adolph's magazine ads stopped abruptly early in 1916, and little is heard from him after that. War-time and post-war conditions may have shut off his supply of receiver forgings, raw barrels, and access to the cadre of craftsmen who didn't resent having Fred Adolph's name stamped on their handiwork.

And not much is known about Herr Fred's gunmaking activity during the 1920's. Without the benefit of advertising (it has been suggested the magazines refused to run his ads) he was graced with enough orders to keep him busy nonetheless. During these years, he put together some stunning rifles, shotguns, and combination guns. There were Springfield sporters, too. He continued to turn out guns good enough to generate flowery accolades from industry giants such as George Eastman of Kodak fame, and Alvan Macauley, president of Packard Motor Car Co. Adolph's plans to build a factory to mass produce high grade sporting arms never materialized. He went so far as to hire a New York City architect to draw up blueprints for a monumental stone building that would have looked more like a two story mausoleum than a gun factory.

In his book *SOUTH OF AUBURN*, Cayuga County, New York's historian Ward O'Hara paints a fuzzy picture of Fred Adolph as the strangest, most eccentric character in Genoa. A great amount of suspicion surrounded his personal activities. Through curtains parted just a crack, village residents watched his peculiar movements, and wondered what this man might be up to. He was frequently sighted tippy-toeing to the railway station on Genoa's east hill, always coming or going with a package roughly the dimensions of a disassembled gun. The local newspaper regularly reported on his perpetual short "business trips" to unbeknown destinations that he was always just returning from or departing to. His domestic and financial instability was the talk of the town. Remember what was going on in Europe in 1914. There were plenty of paranoid, overly suspicious window peekers in Genoa that were convinced Adolph was involved in some sort of espionage activity, and that he was doubtlessly planted in that innocent little hamlet by some devious force from the Motherland of the Huns.

Adolph left Genoa for good in '26. The gossip in the community that year was that he lost his home in a mortgage foreclosure in which fifteen defendants had legal claim against it. When he went bust, Adolph reportedly flitted from one gun factory to another, never staying in one place very long. Gun company officials took turns finding a niche and a place for him. He ultimately settled in Michigan, where the Ford Motor Co. hired him as a master experimental machinist. He resumed painting and his beloved poetry. The word is that he retired to Florida sometime in the early 1950's.

For one man among the masses of German immigrants, Fred Adolph created quite a stir at the time of the Great War, and left a sizeable impression. He garnered more than his fair share of publicity, and skillfully maneuvered to convert a throng of American admirers into a following that failed to really last. Even if the man was guilty of being a trifle egotistical and self serving, in light of his significant contributions, and recognizing the fact that enough of humanity is that same way, recorded history should be kind in regards to judging Fred Adolph.

Adolph's impact on the history of American arms and ammunition was not a terribly huge one. He managed to turn out, or cause to be turned out, a small handful of fine firearms. He left us with a number of heirloom quality examples of the finest of the gunmaker's art, including a handful of the earliest and most historically significant sporting Springfields.

Printed errors

"Errors frequently appear in print. Corrections may appear some time later, but rarely reach all of the people who have read the original. This is how totally incorrect information passes from one generation to the next, until it becomes folklore. The problem is particularly difficult for writers, who necessarily are building on the imperfect foundations laid down by their predecessors..."

... Fred Windoes.

BY GARDNER JOHNSON

The year was 1933, the speaker was my high school physics instructor, Fred Windoes, and the quotation is from memory. Mr. Windoes then gave us a dozen examples...Did you guess?... Several of his 1933 examples neatly turned up intact in PS Special Edition No. 4. dated February, 1997.

It seems to me that it is more important to stop the errors from propagating than it is to deprecate their latest victims...who will not be identified by name in what follows.

The first error appears on page 8 of Volume II in an otherwise excellent article. The author mentioned that "The barrel and chamber of an automatic weapon will expand due to the heat of firing. This will result in the expansion of steel in all directions, which will actually decrease in size the internal diameter of the barrel and chamber'.

The rest of the article and the first one-and-one-half quoted sentences are quite correct, but the last one half sentence is not. The coefficient of linear expansion of steel is roughly ten parts per million per degree C., and the chamber diameter necessarily increases at the same rate as the steel that defines it. The erroneous concept is that there is a "neutral axis" somewhere between the chamber and the outside diameter of the barrel or receiver, and that the metal outside this axis expands outward, while the metal within the axis expands inward. This sounds reasonable and is widely believed...but happens to be incorrect.

The neutral axis concept is useful when analyzing the bending of beams, but is misapplied here. Instead, visualize an axis (a zero thickness line) running straight down the center of the bore; with all expansion outward from it. If it were otherwise, for example, we would first cool rather than heat the outer of two parts to be joined by a shrink fit. Fred Windoes claimed that this specious error has been going strong since the 17th century...today we bedevil people with a modern equivalent...computer viruses...

The article on "The Truth About Measuring Stuff" (Volume one, page three of the same publication) is loaded with Fred Windoes favorite errors. The article's basic theme is well taken, but as political observers like to say, "The Devil is in the details."

The first of many mistakes begins with the correct observation that the value of Gravity varies significantly over the surface of the earth. The incorrect conclusion follows that the quantity of powder weighed out on a conventional beam-balance powder scale will therefore vary in proportion to the local value of Gravity. The catch is that any change in Gravity affects the powder charge just as much as it affects the scale weights, so there is no net error in the quantity delivered. This is one of the important advantages of beam-balance systems.

Actually, about the only effect of Gravity is on the period of oscillation of the scale beam. The period happens to be inversely proportional to the square root of G, among other factors. Using the author's estimate of one part in 200 extreme variation in G over the surface of the earth, the effect amounts to an extreme spread of plus or minus one part in 400 in the time of each swing. The author missed that one, along with the actually significant problem of hysteresis. Hysteresis in beam-balance powder scales results from such factors as nicks and flats on the knife edges and their supports, friction, overloading and contamination.

One scale I once appraised for the widow came from the estate of a man who had obviously smoked carefully but very heavily for years while reloading. The yellow tobacco tar around the main beam knife edges easily held the pointer a full two-tenths of a grain either side of the true balance point. (The tar also gave him another, much more serious problem...)

In contrast, spring scales, such as an ordinary bathroom scale, are completely dependent on Gravity. That is one of the many reasons why they require frequent deadweight calibration when used for

Continued on next page

Printed Errors

Continued

more accurate work. There now are spring powder scales, and that is necessarily how they are used...more about that later.

The same author also questioned the precision with which the weights can be placed in the vee notches of the powder scale beam..."Think you can put that weight in the notch to an accuracy of a thousandth of an inch?" Characteristically, no supporting data is offered. You can easily test the this item for yourself. Weigh a typical bullet, say 100 grains, and carefully note the exact pointer position. Without disturbing anything else, carefully lift one of the weights clear of its notch and place it back again. How different is the new pointer position?... On my own Ohaus M5, which has had 25 or more years of constant use; the variation is less than one-tenth of one pointer scale division. I say one tenth because actually I can see no variation at all, but I can only interpolate the pointer position to about one tenth of a division. Each full division corresponds to 0.12 grains, so the error is somewhat less than one-eightieth of a grain.

The error can also be expressed in inches. The Ohaus M5 scale has 101 notches, including the zero notch, in five inches of main beam length, so the nominal notch to notch spacing is 0.05 inches. Moving the weight one notch is equivalent to a change of five grains of pan loading. To meet the scale's accuracy guarantee of one-tenth grain, the notch spacing must therefore be correct to within one fiftieth of 0.05 inches, or one thousandth of an inch. In practice, the notch spacing needs to be substantially more accurate than that to allow for other sources of error, and for a safety factor on the guarantee. The actual test maximum weight placement error of one eightieth of a grain corresponds to plus and minus 62.5 millionths of an inch, sixteen times better than the questioned distance. The point is that the edges of the sharp vee-notch determine the weight placement, not the operator's ability to work to one thousandth of an inch.

The article also casts great suspicion on scale manufacturer's guarantees of accuracy. The author seems to believe that anything better than one part in 1,000 is highly improbable, but as usual, offers no supporting data. Actual testing of my M5 by a fellow Very Skeptical Senior Scientist (VSSS) found a worst case error of 0.05 grain over the full 505 grain range using NBS (now NIST) class S weights. He spent an entire afternoon and evening testing every one of the 150 notches, trying to prove his point. He found only one part in 10,000...sorry about that. Evidently, this scale was better than the accuracy guarantee by two to one and our author's questioned limit by ten to one. In my experience, that is typical of other quality brands as well.

You will need a magnifier and a horizontal reference line permanently mounted in front of the scale pointer tip to read position that closely. I installed mine because that same VSSS also challenged me to weigh out ten twenty-grain powder charges as nearly alike as I could. He would then check-weigh them on his Christian Becker analytical balance using those same class S weights. Of course I used the finest grain size powder I had on hand, which happened to be 452AA; AA9 would have been even better. The mean of the 10 readings was 19.960 grains; the standard deviation was 0.015 or 0.076%, and the extreme spread was plus and minus one-fortieth of a grain. Very probably any other manufacturer's first quality beam balance powder scale used with extreme care would have done as well.

The author also thought that an error would result from expansion and contraction of the scale beam with temperature because the two arms are of unequal length. To keep it short, powder scale beams are often made of brass for the sake of its good machining properties. Brass is a good conductor of heat, so the entire beam is very closely at the same temperature from end to end. If the ambient temperature changes, the beam will expand or contract accordingly; both segments by the same percentage of their original lengths. The beam-balance equation is thus still satisfied, and no error results.

For an extreme example, suppose that one section of the beam is initially two inches long and the other is four, for a ratio of two to one and the beam is balanced level. Next, assume that the temperature increases so much that each section increases in length by 10%, without igniting the powder charge in the pan or melting the beam. The ratio of lengths is now 4.4 to 2.2, which is the same two to one as before; so the beam is still balanced and the weight indication is unchanged...another virtue of beam-balance scales.

Older high accuracy laboratory balances, such as the Christian Becker analytical balance mentioned above, were equal-arm balances. They were routinely used with a number of well-understood laboratory procedures. For example, to eliminate errors due to friction and hysteresis, all readings were taken with the pointer swinging across the dial, never with it at rest. An odd number of readings of the pointer position at one extreme of motion were averaged with the intervening even number of readings on the other side of zero to determine the equivalent rest position. Weighings were corrected for the buoyant effect of air on the weights and the load, if their densities were unequal. Weights were calibrated with great care against each other, and against standards. Readings were taken with the weights and loads interchanged to correct for inequalities in the lengths of the beams. Weights were handled only with ivory-tipped forceps, and never touched with the fingers. Many other niceties were also observed. The author states without proof that accuracy better than one part in 1,000 is questionable but... My Ohaus M5 is accurate to one part in 10,000 without the niceties; and the old analytical balances easily reached accuracies of parts in 250,000 of full range, limited by knife edge loading and the accuracy of the separate weights.

Incidentally, for a beam-balance scale, the sensitivity depends on the distance between the center of support of the beam and its center of gravity. A vector diagram will make this clear. The older laboratory balances had a very small adjustable slider on the vertical pointer. This allowed the center of gravity of the beam system to be moved up or down a minute amount, thereby adjusting the sensitivity to the user's needs. The adjustment changed the period of the beam oscillation as well...do you see why?

The author next questions the accuracy of piezoelectric powder scales. The piezoelectric effect has to do with the

production of electrical charges on the surfaces of certain materials such as quartz when the material is subjected to mechanical stress. The resulting signals are at a very high impedance level, and tend to drift fairly rapidly from the original value due to electrical leakage. The effect is useful for measuring fast one-shot high pressure transients such as occur in pressure guns, but again the author is completely confused. At the present state of the art, the drift, sensitivity, and complexity problems make it completely impractical to use the effect in any known type of scale. A few scale companies have researched the change in frequency of a piezoelectric oscillator as the crystal is loaded, but no scales based on that effect ever resulted commercially either. Of course his additional questions about linearizing and temperature compensating such a non-existent device are also misdirected.

Today's laboratory scales use electromagnetic force balance systems. Essentially, the load is supported by an electromagnet and the current through the magnet thus provides a measure of the load. The current is adjusted by servo techniques to maintain the support point very close to its unloaded position. The current is measured and digitized with an elegant variation of a digital voltmeter. Once digitized, any necessary corrections for temperature or nonlinearity are easily applied. A typical Sartorius (German-made) laboratory scale, for example, is rated for 5 grams (roughly 77 grains, the weight of a nickel) full scale with a sensitivity of one microgram...one part in five million...

Real-world electronic powder scales use strain gage (not piezoelectric) sensors to measure the bending of thin beams carrying the load of the scale pan and its contents. Thanks to Dr. Oehler, shooters now know that strain gages usually consist either of lengths of fine resistance wire laid out in a grid configuration, or of strips of semiconductor resistance material which are more sensitive but less linear in output. When glued to the beams (or for that matter to a gun barrel) the gage material is stretched when the host material elongates either temporarily or permanently. The elongation reduces the cross-sectional area and increases the length of the gage material and thereby increases its electrical resistance. Contractions have the reverse effect.

Both the gage material and the host material must not be stretched even close to their elastic limits. This means that actual deflections over the gage area are of the order of microinches. By matching the electrical characteristics of the gage material to the mechanical characteristics of the host material and using the gages in symmetrical pairs or quads, good compensation for temperature effects can be obtained. The percentage change in the gage resistance due to the elongation of the host is very small, but is easily measured by the use of Wheatstone bridge circuitry. The analog output of the bridge is then amplified if necessary, and routed through an analog to digital converter chip into a simplified digital computer.

So far, the whole system is fundamentally equivalent to a spring scale, much like a smaller version of your electronic bathroom scale. Both depend on Hooke's law and both will change their indications if used in the presence of different values of Gravity, for example. The electronic powder scale, however, requires a two or three-point dead weight calibration by the user at each turn-on and the digital computer program takes care of the rest. The frequent dead weight calibration makes the accuracy of measurement of powder charges completely independent of the local value of the gravitational constant and almost everything else, just as with the beam-balance scale. Both types have sensitivity and sensibility limits, of course. These are determined in part by such things as the one count quantizing error of digital systems or the hysteresis problems already mentioned.

The author also questions the mathematical techniques employed for the convenience of the user to translate the output signals from non-linear or temperature-sensitive load cells to a zero-based linear scale. "If you torture a statistic long enough it'll scream out whatever you want it to." Actually, of course, what we want to do is to remove the distortion introduced by the repeatable nonlinearity of the load cell. Thankfully, mathematicians are very skilled at accomplishing just that. A review of the actual mathematics here would bring down the editor's wrath. ...But, hint: start with trigonometric splines in Dr. Dobbs Journal; which is the counterpart of Precision Shooting in the world of advanced mathematical programming.

The author also indicates that he is totally ignorant of the development of present day physical standards. He also mentions NIST standards that vary about 3% with respect to each other. That would be of considerable interest to all of us, including NIST. Perhaps he can elucidate?

Incidentally, my first publication in the firearms field was a letter reporting the accuracy of the then-new Pacific Gunsight Company's beam-balance powder scale. Fred Ness included the report in the American Rifleman about 1936.

I am genuinely sorry that the second author's confused examples turned out to be so totally incorrect, because I believe that his underlying thesis is both correct and important. The analysis of instrumentation errors is a highly essential part of data evaluation. Allah willing, someday I will write a book about the incredible foul-ups I've seen during the last 80 years...if they become declassified...

By the way, a great article by Robert Wernick entitled "Declaring an open season on the wisdom of the Ages" appeared in the May, 1997 issue of Smithsonian magazine. The subject is Denis Diderot's 1751 Encyclopedia of Sciences, Arts, and Trades. Diderot would have made a notable instrumentation engineer...he questioned everything that "everyone knows," and frequently proved it wrong. He thus became one of the principal creators of the Scientific Method, which requires both publication and peer review of theories and the supporting evidence. I particularly liked the example of an early biologist's description of the Agnus Scythicus plant; shaped like a sheep, and covered with darkish down which made excellent garments. It grew on the steppes east of the Black Sea. Other biologists slavishly copied the description in their writings for several centuries, until one suspicious soul visited the site and proved the story false...Fred Windoes would have liked that.

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LIGHT BULLETS IN THE .280 ACKLEY IMPROVED

BY ROY L. TOWERS, JR.

For several years a rifle chambered in .280 Ackley Improved has languished in my gun safe. It's a shame, because it really is a nice rifle: premium barrel, trued action, synthetic stock, and excellent optics. I built the rifle back in 1987 when I was doing quite a bit of deer hunting on a large local ranch. This ranch held lots of nice blacktail bucks, and shots at same usually were made across large expanses of God's country. I'd read the merits of the .280 Improved in various articles, and it seemed just the ticket for these long-range shots.

After completing the rifle and developing loads I waited anxiously for deer season to arrive. Opening morning finally came and I grabbed the wondrous .280 Improved and headed for the hills. Soon the opportunity I had waited for presented itself. Just like a script, there was a buck at 350 yards. It was perfect, and my mom and dad were even there to see this beanfield rifle make it's first long-distance kill. I folded down the bipod, laid prone, and carefully gained my sight picture. I squeezed ... and missed.

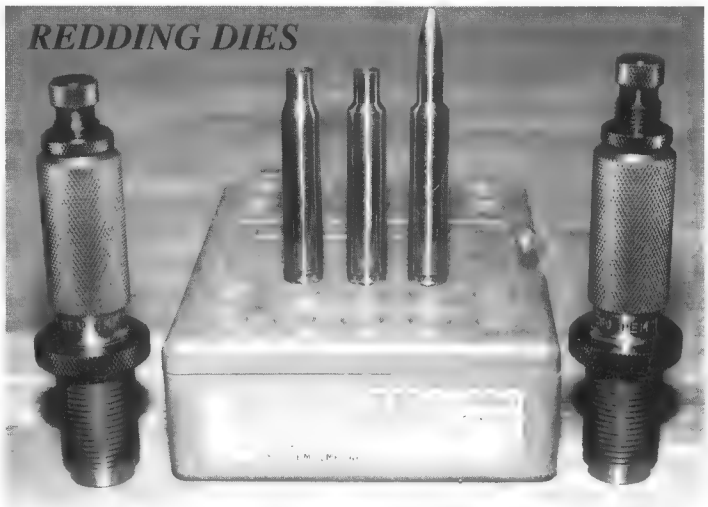
Oh well.

Later I did take several bucks with the .280 Improved at various distances. It was very effective and bounced bucks off the ground as if struck by lightning. The rifle and cartridge were everything I'd hoped for. But alas, I'm a sentimental fool. You see, I've got a .270 Model 70 Winchester that my dad gave me when I was 12 years old and I can't bear to leave it at home when it's time to hunt bucks. I've packed my .270 around for 30 years now and I've used it to take over 60 head of big game. That old .270 is no less than an extension of my soul.

So while the .270 accompanied me on my regular hunting forays, the .280 Ackley Improved gathered dust. But the .280 Improved is such a nice rifle that it seemed a shame to leave it unused. I began to wonder if I could use it for coyote hunting. I was intrigued with the idea of loading light-for-caliber (100 to 110 grain) bullets to high velocities for slaying coyotes at great distances. I looked far and wide for loading data for the .280 Improved for this range of bullet weights but found none. Thus, I had no alternative but to perform my own loading experimentation. I'd like to share my results of loading light bullets in the .280 Improved with you.

To begin, I'd like to give you some background of the .280 Improved cartridge and my rifle. I won't go into great detail in describing the history and characteristics of the .280 Ackley Improved cartridge. A fair amount has been written about the .280 Improved, most notably Kenny Jarrett's Precision Shooting article of April, 1996. Suffice to say, the case is formed by firing a standard .280 Remington cartridge in the improved chamber. Cases thus formed take on classic Ackley configuration (40° shoulder, minimum body taper), and gain about 9% greater case capacity (67 grains of water for the standard .280 Remington vs. 73 grains of water for the .280 Improved). It is an efficient cartridge and medium-weight bullets can be driven to velocities essentially equal to those produced by the 7mm Remington Magnum using less powder. The improved design handles pressure well, and case stretching is minimal.

The basis for my rig is a Remington model 721 action. My dad gave me this action as part of a complete rifle in .270 caliber (we are a .270 family) that he purchased new in the 1950s. The 721 is the precursor to the Remington 700 long action and the two are very similar. The casual observer will notice only a few cosmetic differences. However, the 721 has two design weaknesses that Remington later corrected in the model 700, and one may wish to likewise correct these weaknesses if a 721 is to be used as the basis of a custom rifle. First and foremost, the 721's case extractor is prone to failure and original factory replacements are difficult, if not impossible, to find. My extractor was virtually inoperative when I acquired the action, so I had it replaced it with a Sako extractor. There are many competent gunsmiths capable of installing Sako extractors, and the cost of parts and installation is in the neighborhood of $125.00. My Sako extractor functions flawlessly.



Left to right: standard .280 Remington, fireformed .280 Ackley Improved case, loaded .280 Improved round.

The second mechanical weakness of the 721 is the trigger. It is a seemingly-crude affair when compared to the model 700 trigger. The housing is made from a single bent piece of stamped sheet metal, and the sear is comprised of two separate pieces. As provided from the factory the trigger is sloppy and heavy (what factory triggers aren't?). Conventional wisdom is that the 721 trigger is a piece of junk; however, a shooting friend advised me that the 721 trigger can be honed and adjusted into an excellent hunting trigger. I found this to be true. The work involves honing all contact points to a fine finish with abrasive stones, and polishing the interior surfaces of the trigger housing with fine abrasive cloths to remove all burrs and rough spots. It also involves fine tuning of all adjustment screws. When thus honed and adjusted, the trigger ain't pretty but it is crisp and consistent. I can't tell the difference between my 721 trigger and a similarly-reworked 700 trigger. A word of caution, however: trigger work should be performed only by a competent gunsmith. Triggers are touchy and potentially dangerous mechanisms.

A local gunsmith blueprinted my 721 action and installed with a 7mm, 26" Hart stainless barrel. I intended this to be a "carry-around" hunting rifle, so I opted for a relatively light barrel (a no. 5

.280 Ackley Improved rifle & victim.

contour, which is considered a "light varmint" weight). The twist rate is 1 in 10". The barrel is bead blasted to reduce glare and aid in heat dispersion. My early tests with 140 gr. Nosler Ballistic Tips proved the barrel to be an accurate one. It was not unusual to shoot .5 minute of angle (MOA) groups (three shots) at 3200 ft/sec. One rather spectacular group measured .222 MOA. The barrel fouls very little, as is characteristic of fine premium barrels.

My original budget for the .280 Ackley did not include a new stock, so for a time I used the factory 721 wood stock. I pillar bedded the factory stock and the rifle shot accurately. However, 721 stocks were designed for open sights and drop quite a bit at the butt. This lead to a fearsome recoil pounding when I shot it from the bench. To remedy this situation I recently purchased and installed an HS Precision thumbhole stock. This stock is available for Remington 700 long actions in the BDL version only, so it needed to be modified to fit the 721. HS Precision performed some of this modification (which consisted of inletting for the trigger and safety lever) free of charge. In addition, I modified the bottom of the magazine area to accept the 721's original magazine cover/trigger guard. The alternative would have been to purchase Remington BDL bottom metal, which was expensive at the time and didn't seem worth it. (BDL bottom metal is now available through Brownells for a reasonable price.)

The HS Precision stock features an aluminum bedding block that is designed to mate with the bottom of the action. It is said that this block not only adds stiffness to the stock but also to the action (the idea is that it functions as a kind of bolt-on action sleeve). HS advertises the stock as a drop-in system. It may very well shoot accurately as a drop-in, but I prefer to bed it with Devcon aluminum epoxy. I have bedded and experimented with several of these stocks, and results have always been excellent. My HS Precision stock is a pleasure to shoot, and it is esthetically pleasing as well. Accuracy has improved, no doubt in part because the rifle is now more comfortable to shoot.

I have used several scopes on this rifle. For this test I installed a Burris 6 x 24 Signature scope with target knobs. This is the first Burris scope I have owned. Shortly after buying it I set it along side a Leupold 6.5 x 20 and compared the two at 20 power. To my eyes (which are still good - although everything else has gone to hell) the Burris presents a sight picture that is at least as clear as the Leupold, and the Burris has a wider field of view. Also, the Burris scope has a light regulating feature which allows the shooter to adjust an iris in the scope for various light conditions. The iris can be opened wider for low-light conditions, or narrowed for full light. I am impressed by the quality of the Burris scope. It functioned flawlessly throughout my tests and I plan to purchase more Burris scopes in the future.

To begin my research of loading light bullets in the .280 Ackley Improved I contacted Kenny Jarrett, who kindly provided me with some loading parameters. I also consulted the current Nosler reloading manual, which contains loading data for the .280 Ackley, starting with their 120 grain Ballistic Tips. From their loads for the 120 grain bullet, I was able to extrapolate starting loads for 100 and 110 grain bullets. The only bullets I tried that are heavier than 110 grains are the 120 Barnes X bullets. I shot these because I may use them on deer during the upcoming season (if I can tear myself away from my beloved .270).

All cases were fire formed from new Remington .280 brass. Cases may also be formed from previously-used brass, but I strongly recommend that they first be properly annealed to eliminate the possibility of ruptures or split necks. Preparation of my brass included outside turning of the necks to .012" (which was enough to just clean them up) and uniforming the primer pockets and flash holes.

For loading I used Redding .280 Ackley Improved dies, which are readily available on the market at a reasonable price. All tests were conducted in temperatures ranging from 60° to 75°. I cleaned the barrel after every 13-round string (consisting of one fouler and four three-shot groups) with GM Top Engine Cleaner and Barnes CR-10 Bore Cleaning Solvent.

Included with my loading data are the sizes of the groups produced from the various loads. I have included these for information purposes only, as accuracy will vary from rifle to rifle. I did not experiment with seating depth, so these groups may not even represent full accuracy potential in my rifle. It is left for the reader to experiment with seating depth for all bullets to obtain maximum accuracy. Most bullets were seated to just touch the lands. The exception are the Barnes bullets, which I seated .050" from the lands. These bullets are made of pure copper, which is harder than normal jacket material and builds pressure differently. Barnes recommends that the reloader start by seating the bullet .050" from the lands, and then adjust seating depth for accuracy. One must keep in mind that, typically, the closer the bullet is seated to the lands the higher the pressures will be.

The accompanying load table sets forth the results of my load testing. All loads listed herein were safe in my rifle on the day they were fired. **Neither this publication nor I make any representation as to their safety in your rifle.** Approach these loads with caution!

BE CAREFUL! I'M NOT KIDDING! Let me tell you a little story. Late one Friday night (sober - honest!) I was preparing loads for my next day's shooting. I loaded 15 cartridges with 100 grain Hornadys and (I thought) H414 to use as foulers and for setting up my chronograph. When I fired one of these loads over the chronograph, it registered 3850 ft/ sec! Needless to say something unusual had happened! I was able to open the bolt by pounding on it with a splitting maul (I am a sensitive, delicate man). I never did find the primer.

Although I am not a Rhodes scholar, I was able to deduce that it would not be safe to shoot any more of these loads. When I returned home I discovered that I'd substituted H414 with H322. (What's the difference? They both have one letter and three numerals.) The good news is I set a new world's speed record for 100 grain bullets. The bad news is it will be entered in *The Guinness Book of Records* under the "stupidest shooter" category.

I've made this confession to illustrate a point. Pay attention and be careful! In our increasingly litigious society people tend to blame their own mistakes on someone else. Let the shooting fraternity be above this all. Only you are responsible for what you shoot through your rifle!

Anyway, now that I'm off my soapbox, what are my conclusions of the performance of light bullets in the .280 Improved? To be honest, I believe I achieved mixed results. I did not attain the velocities I expected with many of the bullet/powder combinations I tried. It was easy to attain 3400 ft/sec. with 100 - 110 gr. bullets, but I was

Continued on next page

Light Bullets in the .280 Ackley Improved

Continued

excepting higher velocities. The good news is that my rifle can safely attain 3600+ ft/sec. with IMR 4064. I first attained this velocity with 100 gr. Hornady bullets. Subsequent to drawing up the loading table I tried this charge with 100 gr. Sierras, since these seem to be the most accurate bullets in my rifle. My pet load is 58 grains of IMR 4064 behind 100 grain Sierras seated to just touch the lands. This load shoots consistently less than .5 MOA at about 3650 ft/sec.

And how does the .280 Ackley with light bullets work on coyotes? Well, I got the chance to try it outlast April. My hunting partner and I set up on a high ridge overlooking a basin. After calling for about 20 minutes my friend spotted a coyote at the far end of the basin (about 325 yards). It was perfect. I folded out the bipod, laid prone and carefully gained my sight picture. I squeezed ... and experienced instant satisfaction!

LOAD TABLE — 280 ACKLEY IMPROVED

BULLET	POWDER	CHARGE	IV[1]	MOA[1]
100 Sierra HP	H380	54	3246	.490
		55	3361	.597
		55.5	3377	.408
		56	3385	.455
		56.5	3388	.917
		57.5	3364	.506
		58.5	3389	.788
	H414	55.5	3249	.568
		56.5	3288	.565
		57.5	3303	.733
		58.5	3386	.565
		59.5	3403	.533
		60.5	3436	.733
	H4831 SC	61	3038	.490
		62	3130	.369
		63	3212	.615
		64	3249	.735
		65	3220	.846
100 Hornady HP	R-19	63	3331	1.843
		64	3394	.333
		65	3419	1.037
		66	3472	.681
	IMR4064	55	3396	1.454
		56	3474	.842
		57	3522	1.134
		58	3606	.336
		59	3714	1.357
	IMR3031	52	3348	1.337
		53	3395	.683
		54	3384	1.076
		55	3434	.735
100 Barnes X	IMR 4350	59.5	3253	1.511
		60.5	3325	1.716
		61.5	3387	2.922
		62.5	3454	1.197
	W760	54	3178	.999
		55	3164	1.346
		56	3188	1.420
		57	3174	1.420
		58	3388	1.324
AAC 3100		61	3127	.876
		62	3157	1.043
		63 *	3236	.960
		64 *	3256	1.292

*(compressed load)

BULLET	POWDER	CHARGE	IV[1]	MOA[1]
110 Speer TNT	IMR4064	54	3268	1.347
		55	3338	1.028
		56	3403	.827
		57	3464	.913
		58	3531	.399
	IMR3031	50	3187	.733
		51	3221	.509
		52	3257	.460
		53	3339	1.138
		54	3409	.642
	IMR 4350	57	3081	3.363
		58	3088	.991
		59	3176	1.007
		60	3252	1.399
		61	3298	1.614
		62	3362	.681
		63	3430	.693
	H380	54	3136	
		55	3191	.455
		56	3242	.788
		57	3259	1.026
		58	3302	1.056
120 Barnes X	H4831 SC	60	2976	1.392
		61	3048	1.117
		62	3074	1.841
		63	3161	2.258
		64	3231	1.607
	H414	55	3079	.817
		56	3129	.606
		57	3231	.865
		58	3282	1.608
		59	3292	1.047
	IMR 4350	59.5	3200	2.103
		61.5	3360	1.337
		62.5	3341	3.640

[1] Instrumental velosity - mid-point of chronograph screens 10' from muzzle.

[2] Group size expressed in minute of angle for three-shot groups fired at 110 yards.

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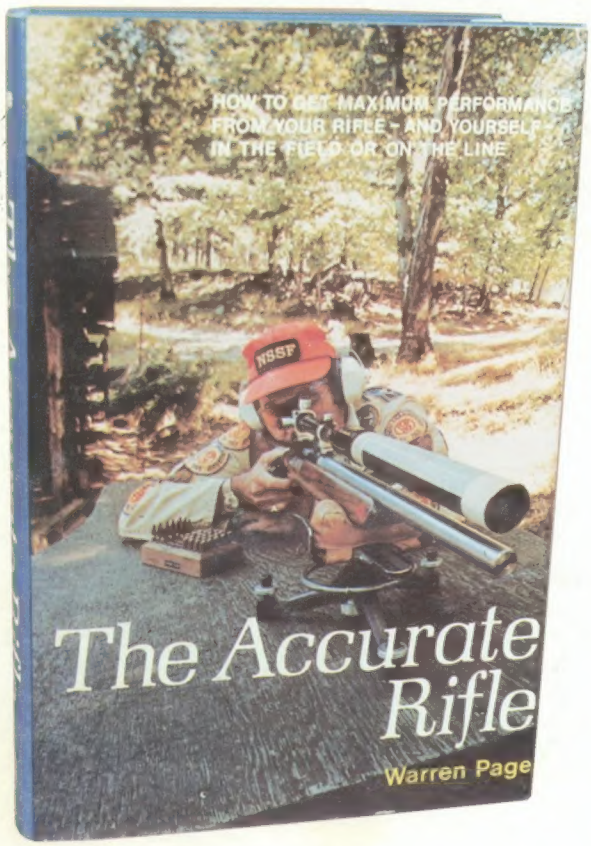
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NSSF
The Accurate Rifle
Warren Page

The Accurate Rifle

by Warren Page

The 1996 reprint carries every word and photo of the 240 page, 1973 dated original, totally unchanged. In addition, at the very end of the book is an "Update - 1996" chapter, authored by Dave Brennan, Editor of *Precision Shooting* magazine, which will bring the reader up to date on rifle equipment developments that took place between 1973 and 1996.

The topics include the best methods of shooting from bench rest; the most accurate sights and scopes and how to turn them to your advantage; the effect of recoil; the most accurate cartridges; the secrets of proper bedding; how to select barrels and stock; how to clean an accuracy rifle properly; trouble shooting-everything that Page's years at the top of the shooting world have taught him. In addition, *The Accurate Rifle* can be read as an absorbing history of the most dynamic period in the search for accuracy - the last two decades - for Page was there, and he not only knew the pioneers but he was one himself.

From an obituary of the time, for Warren Page's 1977 death:

"Page was an accomplished shotgunner and almost without peer as a rifleman. He held countless world and national records in benchrest shooting - a sport he helped guide through its infancy during the early '50s. At the bench, he was a national champion nine times. He contributed immeasurably to the store of technical knowledge on firearms and ammunition and helped pioneer the introduction of several of today's modern high-velocity cartridges (Primarily the .243 Winchester and the 7mm Remington Magnum)."

Precision Shooting has purchased the entire run of 5,000 copies of the updated edition of *The Accurate Rifle*. The book will be available in both hard cover and soft cover versions, as was the original edition.

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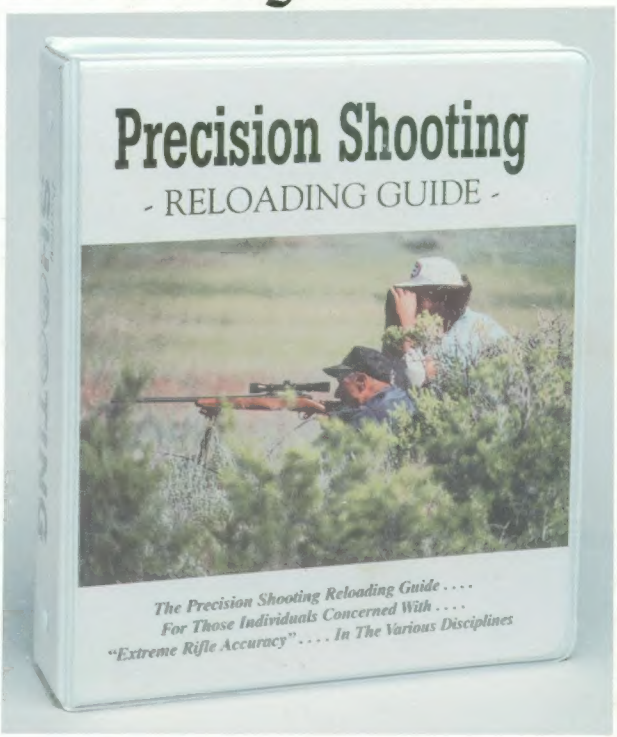
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